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PLANNING AND UTILIZATION OF A REGIONAL DATA BANK FOR EDUCATIONAL RESEARCH PURPOSES. FINAL REPORT.
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ON AUGUST 1, 1964, HARVARD GRADUATE SCHOOL OF EDUCATION BEGAN A STUDY TO INVESTIGATE THE FEASIBILITY OF ESTABLISHING A REGIONAL DATA BANK FOR EDUCATIONAL RESEARCH PURPOSES. THE PLAN INCLUDED CONVENING A SERIES OF CONFERENCES OF EDUCATORS TO DETERMINE WHAT SUCH A DATA BANK SHOULD CONTAIN AND WHAT FORM IT SHOULD TAKE. THE STUDY WAS CONDUCTED IN THREE PHASES--(1) PLANNING OF THE CONFERENCES, (2) CONDUCTING THE CONFERENCES (UNIVERSITY RESEARCHERS ON DECEMBER 3-5, 1964, STATE DEPARTMENTS OF EDUCATION ON MAY 26, 1965, AND SUPERINTENDENTS ON JULY 8, 1965), AND (3) WRITING OF THE REPORT. CONCLUSIONS FROM EACH OF THE THREE CONFERENCES AND PAPERS PRESENTED ARE INCLUDED. (HB)

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PLANNING AND UTILIZATION OF A REGIONAL DATA BANK FOR EDUCATIONAL RESEARCH PURPOSES

FINAL REPORT

Contract No. OE 5-10-097
with Cooperative Research Program
Office of Education
U. S. Department of Health, Education, and Welfare

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ABSTRACT

On August 1, 1964 Harvard Graduate School of Education entered into contract no. OE 5-10-097 with the United States Office of Education to investigate the feasibility of establishing a regional data bank for educational research purposes. The plan of the study was to convene a series of conferences of educators to elicit from them notions of what such a data bank should contain and what form it should take. An outgrowth of this study was the preliminary establishment of a regional educational data bank at the New England Education Data Systems, Cambridge, Massachusetts.

The conclusions reached by the principal investigators are as follows:

1. A regional data bank for education can contribute substantially to the conduct of educational research.

2. The storehouse of data--the data base--which forms a part of a data bank is not defined in terms of location, but in terms of accessibility. Not only is it not necessary for one to own data in order to consider them a part of a data base, one need not possess them either. It is not the presence of a thing, but rather the access to it that is central, and therefore we consider credit a better analogue than money to the contents of a data bank.

3. The contents of a data bank are insufficient to define it. We suggest that a bank and a vault are different things, and a data bank, therefore, is not a container of data but rather a mehcanism for the processing of educational commitment and for the enhancement of the capability of educators at various levels of concern to communicate. The currency is data but they are ineffective as media of exchange without the commitment and the communication which such exchange implies.

PREFACE

One of the most promising developments in education arising from contemporary computer technology has been the growth of local, regional, and possibly national data processing facilities offering school systems a means of performing very rapidly and accurately such tasks as the compilation of school statistics, the scheduling of classes and the assignment of pupils thereto, the production of pupil report cards, the scoring and norming of tests, the creation and updating of pupil cumulative records, and the maintenance of teacher personnel files.

Whether or not they are intended to do so, these educational data processing centers are accumulating large stores of educational data of various sorts. For the most part, data are collected and analyzed for immediate administrative use, but at the same time, it may be that these data have great utility for research on the general problems of education, particularly if care is exercised in the selection and organization of the information. It was to deal with this latter problem that the Harvard Graduate School of Education entered into contract no. OE 5-10-097 with the United States Office of Education to conduct what came to be called the Study of the Development and Use of Data Banks for Educational Research.

The need for the project was jointly perceived by William W. Cooley (then on the staff of the Graduate School of Education), David V. Tiedeman, and John B. Carroll, since all were interested in the possible uses of educational data banks in certain kinds of educational research. Cooley and Tiedeman were especially interested in data banks as tools in developing data for school guidance and career development research purposes, while Carroll was particularly concerned with the data bank as a source of information useful in evaluating the school program as a whole and in conducting research on instruction. The original proposal for the contract was written mainly by Cooley, who was to have been principal investigator, but upon his leaving Harvard to become director of Project TALENT at the University of Pittsburgh, Carroll took over this responsibility.

The project may also be regarded as an outgrowth of the establishment of the New England Education Data Systems (NEEDS), an educational data processing facility founded by the New England School Development Council (NESDEC) in 1960 to serve the operational data processing needs of participating school systems from the New England region. NEEDS was funded both by contributions from the school systems and a grant from the Ford Foundation, but these funds were to be used solely for the development of the operational program. The role of a data processing facility like NEEDS in educational research remained to be defined.

Pursuant to the original proposal, the study was conducted in three phases. The first phase was to plan a conference (actually, three conferences) on the need, purpose, and design of a regional data bank. Phase two was the actual conduct of these conferences: (1) a conference of university researchers on December 3-5, 1964; (2) a conference of representatives of state departments of education on May 26, 1965; and (3) a conference of school

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superintendents on July 8, 1965. Phase three is represented essentially by the writing of this report and the activities associated with the actual planning and implementation of a regional data bank based at NEEDS.

This report was written and assembled largely by Allan B. Ellis; Carroll, the Senior Investigator, contributed a number of sections and was responsible for editing the whole.

It is pleasant to record and to acknowledge the contributions of many other persons to the activities of the project and the completion of this report.

First of all, we wish to acknowledge the contributions of the many participants in the three conferences convened under this project. All of these served without compensation, even though in many cases they prepared and delivered papers to the plenary sessions or were responsible for chairing and reporting on small group discussions. It is a token of the high interest of the profession in educational data banks that so many prominent persons in university educational research, state departments of education, and school administration accepted invitations to participate in the conferences that were held.

Mr. Walter King Gillen, Research Assistant during the academic year 1964-1965, worked on the project from the beginning. He was of invaluable assistance in the planning and execution of the conference of university researchers and the outlining of the final report.

Mr. John Kirsch was of substantial assistance in the writing of Chapter 4. Mr. F. André Favat, a student in the Graduate School of Education, edited the summaries of the committee meetings and helped with the outlining of Chapter 1. Mr. José Rios-Garau and Miss Georgianna Collins worked on preliminary summaries of the four data banks described in the Appendix. Mr. Barry S. Newman served on the project in such varying capacities as offset operator, messenger, and general handyman. To all of these we are much indebted.

Mrs. Jacqueline Hargrove made a special contribution to the project not only by her very high level of secretarial capacity but also by virtue of her devotion and diligence in all phases of the project. We are especially pleased to acknowledge her participation.

We wish also to acknowledge the help and encouragement furnished by Dr. E. Gil Boyer, Administrator of NEEDS, in many phases of the project, especially the logistic assistance of his staff in the conduct of the conferences and the provision of space and computer facilities at the NEEDS offices for various activities of the project.

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Chapter 1

Proceedings of a Conference of University Educational Research Specialists

If any consideration is to be given to the possible use of educational data banks for educational research, the first question to be raised is what kinds of research might be facilitated by the development of such data banks. To answer this and related questions, a conference of educational research specialists was convened in Boston for the three-day period December 3 to 5, 1964. The participants, listed on pp.38ff, came from all parts of the country and were selected for their prominence in various branches of educational research. They included educational psychologists, educational measurement specialists, educational sociologists, curriculum research specialists, educational data processing specialists, researchers in the field of educational administration, and others who were thought likely to make significant contributions to the success of the conference.

In advance of the conference, the prospective participants were sent a prospectus which explained the purpose of the conference and the planned agenda. The prospectus focussed attention on the following questions pertinent to educational data banks:

1. Is the concept of an educational data bank useful at all? Should educational data banks be established, or should efforts to develop them be abandoned?

2. Ideally, what should a data bank contain? Indeed, can any firm specifications be made for data banks in view of the fact that school conditions and the needs of educational researchers may change continually?

3. In what form should the data be organized? (The concern here was not with technical details of computer storage and data retrieval, since these details are generally specific to the particular software and hardware employed, but with the specifications for data organization.) What particular problems would be encountered in updating information in the data bank?

4. How should the data be collected? What problems may arise in coordinating diverse kinds of data from different school systems or in attempting to obtain at least a modicum of uniformity among school systems in the kinds of data collected and the formats in which they are obtained?

5. What types of research might be attempted by drawing upon the resources of educational data banks? What kinds of research would be especially facilitated by the availability of such resources? What kinds of research answers might be expected, and what would the utility of these answers be?

6. How can educators draw upon the data accumulated in data banks? What administrative arrangements might be involved in the use of data banks, particularly where data banks are also used for ongoing administrative procedures in school systems? How can possible conflicts of the interests of administrators and researchers be avoided?

7. To what extent can educational data banks contain data truly representative of the total educational endeavor in their respective regions?

8. How can a data center foster increased communication among universities, state departments of education, and local school systems?

During the opening session, John B. Carroll, conference chairman, delivered the following keynote address, which set the tone of the conference and oriented the members to the possible nature and function of educational data banks.

OPENING ADDRESS: JOHN B. CARROLL

Many innovations in education start in various parts of the country, and then they just grow, with the result that sometimes they become unwieldy, non-functional, and uneconomical, or they become so specialized that they are not generalizeable to situations in other parts of the country. We are rather afraid that something like that may occur in the case of educational data banks. For convenience I am going to call an educational data bank an EDB, and I hope to use these initials and perhaps give them circulation just as we have the initials EDP for educational data processing.

With the development of EDBs throughout the country, we are sure that some kind of coordination and joint planning among individuals interested in such EDBs will be useful. We will hear this morning about one such EDB, the one Prof. Lindquist is developing in Iowa. The present conference, which is being supported by federal funds, is intended to provide answers to the problems that can be applied *nationwide*. Therefore, we have invited people from all parts of the country--not only from the New England region, in order to achieve a truly national representation.

What is an EDB? I would define it as a large, systematically and periodically collected and maintained store of data from a defined sample of a finite population of schools and/or of their pupils, teachers, and other personnel. This store of data would be efficiently recorded and coded so any selected aspect of it could be readily retrieved.

Most likely the data would be stored on some highly efficient medium such as magnetic tape or microfilm. I question the efficiency of recording data on punch cards for any permanent storage purposes.

This conference is not going to be concerned with the "nuts and bolts" aspects of EDBs. We do not expect to spend very much time on how one would code data, how long it could be stored, or how one would retrieve it; we will leave these problems to the technicians.

We will assume that an EDB would normally be associated with some kind of educational data processing facility. There would be little point in setting up an EDB specifically for research purposes. There are specialized educational data banks such as that assembled with Project TALENT, but generally speaking, an all-purpose EDB would probably be associated with an educational data processing facility.

In the collection of data for an EDB, more or less standard procedures would be carried out routinely and periodically. There would be a series of relevant variables which would be collected as a matter of course. The data would be "maintained" in the sense that any data that change over time, such as the performance of students, or the experience and training of teachers, would be periodically updated, while relevant past data would be preserved. In this way, an EDB must be a *dynamic* data bank. (This phrase I owe to William Cooley.)

The problem of the control and direction of an EDB should be considered at this conference. We ought to think about who would design an EDB; who would manage it; and then, of course, who would use it, and under what conditions; and where it would be most efficiently maintained.

I have already given tentative answers to some of these questions, on the assumption that an EDB would normally be maintained at an educational data processing facility of some sort. We could perhaps distinguish a number of varieties of data banks: local ones maintained in schools or in city school systems; regional data banks maintained in large metropolitan areas, in states, or in aggregation of states; and national data banks.

Howard Hjelm[1] has already published an article concerning the possibilities of a national data bank at the Office of Education, but the focus of our present conference is on *regional* data banks, because we feel that the most efficient way of accumulating and analyzing large quantities of data would be on a regional basis.

There are probably several ways in which data banks could be used. First, let us distinguish between the data bank and the kind of ephemeral data pool that is used in routine school administration. Educational data processing facilities are now grinding out a good deal of data of this latter sort; data on course selections of students, marks of students, and items of that sort which may or may not be regarded as having purely ephemeral usefulness. I think of a data bank as something which is especially designed for the answering of broader questions of educational policy and research. One such use would be a kind of educational accounting that might be illustrated by an analogy. At a recent conference celebrating the 125th Anniversary of the American Statistical Association, someone remarked that the gross national product had increased by forty billion dollars in 1964. Obviously such a remark is based upon data from what may be called economic intelligence operating at a federal level. Perhaps we need something like this in the field of education.

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[1] Hjelm, Howard F. "Applications of Modern Data Processing at the Office of Education," *Harvard Educ. Rev.*, 1961, 31, 237-243.

Thus, educational data processing facilities and the associated data banks would be used as a means of "educational intelligence" to give us a notion of "how the schools are doing." We would want to keep track of many things, such as educational growth of school populations, of individual students, of teacher experiences, teacher training, and many other aspects.

The use of the data bank for this purpose would be essentially descriptive, although we might also build some kind of monitoring function into the data bank, more or less along the lines of cybernetic feedback. We would like to have data banks that if necessary would automatically send up warning flags that something is wrong, that pupil growth, the school population growth rates are dangerously overflowing or predicted to overflow the schools or that individual students are going below expected levels of achievement. This is a possibility we ought to consider at this conference, but this is only one way in which EDBs can be used.

The second major use of an EDB would be for educational research, whether of conventional or unconventional sorts. Educational research, I take it, is designed to study and improve educational procedures of all kinds. In such research, we could use an EDB either for the location of data that have already been routinely collected or for the identification of samples on which we would collect new data.

Both these uses of educational data banks would be important for shaping educational policies and procedures. I would underline the importance of data banks for shaping educational policies because a great deal of educational research is done not so much for directing particular procedures in particular classrooms, but for deciding such major policy issues as who should be educated, with what curricula, etc. The scope of this conference is to deal with *all* these problems of data bank creation.

I would like to say a little about the particular background of this conference. Three or four years ago some of us at Harvard conceived the idea of developing an educational data processing facility for schools in the New England region. I do not think that we would have been interested in this at all simply as a service function; as an educational researcher I would have little interest in the development of the educational data processing facility if I did not expect that it could be used in some way for educational research.

Developing these data processing facilities was a rather long process, but from very small beginnings, we have established finally an organization known as NEEDS, New England Education Data Systems. Currently NEEDS is funded by the Ford Foundation for about $490,000.00, but that support is only for operational expenses. The educational research aspects of the data processing facility were not supported by this fund.

The idea of NEEDS was to develop a system which eventually would become self-supporting as an operational facility. We hope eventually to include about 100 school systems in the New England region. Presently we have 30 school systems at various distances from Boston participating in this facility.

The NEEDS organization is presently structured in such a way that we have four areas. One is data processing as such, and this is the operational element that turns out the work for the schools, doing such things as class scheduling, reporting of marks, and automated attendance accounting.

The second area is operational research and development. Here new programs are developed for educational data processing, but generally not for educational research as such.

A third area is in-service training. NEEDS has found it necessary to run numerous conferences in order to provide necessary training for the personnel in the schools who are cooperating with this data processing facility.

The fourth area is research; it was this area that was not funded by the Ford Foundation. It was felt, however, that in order to plan for the fulfillment of our objectives in the research area, it was necessary to do some planning. A subcommittee of the governing board of NEEDS was formed in order to do this; and it was that committee that encouraged us to submit a contract proposal to the Office of Education.

We now have, therefore, a contract which enables us to hold this conference and do further planning. The contract runs for one year, through July 31, 1965. We hope that the outcome of this particular conference will enable us to plan further activities, perhaps further conferences concerned with various technical and administrative problems. But this conference is particularly addressed to research people, to the people who presumably have research ideas--people who might wish to use educational data banks.

We want to formulate problems of research and then consider what would be the characteristics of an educational data bank that would be suitable for solving such problems.

We hope that the conclusions reached here will not be limited by present technology, and present technology is *not* very limited, even at that. I do not think that we have to go into the characteristics of modern data processing technology. We will assume that either you are familiar with all the statistics on the number of nano-seconds that it takes to do a multiplication, and how many bits can be recorded on a magnetic tape, or that you do not need to be familiar with them. It is our hope that the conclusions reached here will be prescriptive of the kinds of things that could be done with educational data banks. We hope also that the conclusions will be valid for any regional data bank whether in New England or anywhere else in the country, and that the conclusions will be in some measure prophetic.

As for the structure of the conference, there are two stages of our considerations.

In the first, we shall consider the creation, the maintenance, and use of EDBs from the standpoint of the substantive areas of research interests. The committees for this first stage are organized around the five divisions of the American Educational Research Association since the purpose here is to think particularly about problems that could be approached through the use of educational data banks; the divisional structure of the AERA seemed to offer a tentative classification of such problems.

The second stage of the conference will be concerned with the creation, maintenance, and use of data banks from the standpoint of the types of data which are likely to be accumulated.

I would like to list a few of the kinds of questions that each committee might consider. Most important, I think, is to list or to characterize the kinds of educational research problems that an educational data bank might be used to solve. Above all, we are interested in the objectives of educational research and only secondarily with the role that the EDBs might play in that. We want to consider, however, for any given research problem, is an educational data bank useful at all?

We might answer that question in the negative for a large number of problems. This is certainly a possibility, and the conference might even come out with the recommendation that the whole idea of educational data banks is fallacious and that it is just an educational researcher's dream which should be summarily dispatched to Limbo. It would not hurt anybody's feelings to have this conclusion emerge.

There are some individuals here who will argue strongly, as a matter of fact, that the concept of the educational data bank is a fallacious or unwise one in some respects, but on the other hand, there are others here who are very much in favor of the establishment of EDBs. Therefore, it is perhaps up to these latter to demonstrate the need for EDBs for the kinds of problems that they have in mind.

Another problem is, what kinds of data are needed? What kinds of data would you want to accumulate in a data bank? What would be the procedures for the routine collection of such data? What procedures should there be for eliminating excessive redundancies in the data? Hjelm's article cited earlier points out that the redundancy in the data collected at the Office of Education is tremendous; that something like 8,000 different bits of information are collected, but these pieces of information could be collected from only 800 different points.

What procedures should there be for operating and maintaining the data bank? What procedures should be established for the routine analysis and interpretation of data, where applicable? What procedures would be used in special analysis of data for a particular research purpose? What special procedures would be necessary or should be established whereby the resources of an EDB would be made available to qualified researchers? Are there some policy problems with regard to the privacy of data, for example, and the legal control of data, that should be taken care of in order to not embroil educational data banks with various kinds of legal actions?

What kind of restraints or special conditions should be imposed upon the use of data from data banks by researchers? What kinds of implications do all these considerations have for the creation and management of an educational data bank; that is, who should organize and control the data bank? Are there any special physical characteristics that an educational data bank should have for optimal utilization?

Some very general statements should be made about the arrangement, availability, and retrievability of the data in an EDB. What special characteristics would particular educational research problems have, and what implications would these problems have for the way in which relevant data were filed? For example, a longitudinal study would presumably require that students be identifiable from time to time, and it would be rather unfortunate to have the yearly data collected on students accumulated in separate files.

Should there be pilot research to investigate the feasibility of educational data bank procedures? And finally, what kinds of special training would be necessary in order for educational data bank personnel to communicate with researchers, and conversely, what kinds of training would educational research workers need in order to utilize an educational data bank to the fullest extent?

COMMITTEE REPORTS: PHASE ONE
(SUBSTANTIVE RESEARCH AREAS)

The agenda for the conference called for two sets of small group discussions. The first set, comprising what was called Phase One, was one in which the participants were organized around major types of substantive educational research questions. For this purpose, the current divisional organization of the American Educational Research Association (AERA) was employed to specify five areas for discussion. A committee was formed for each area and a chairman designated to lead the discussion, as follows:

1-A Administration, Donald P. Mitchell, Executive Secretary, New England School Development Council (NESDEC), chairman

1-B Curriculum, Arthur Foshay, Teachers College, Columbia University, chairman

1-C Instruction and Learning, John B. Carroll, Harvard University, chairman

1-D Research Methodology, Julian Stanley, University of Wisconsin, chairman

1-E Student Development and Personnel Services, David V. Tiedeman, Harvard University, chairman

Participants other than the chairmen were free to join a committee of their own choosing, although certain suggestions were made as to desirable groupings.

Each committee chairman presented a report, in a plenary session, of his committee's discussion which was then subjected to comment from the other conference participants. The following are summaries of each Phase 1 committee meeting.

1-A Administration, Donald P. Mitchell, chairman

The participants directed their attention first to what many of them felt was an essential dichotomy between "existing data" such as student enrollment or teachers' ages, as kept by local school systems, the states, or the federal government, and "new data" which would be relevant for research purposes.

The participants initially agreed that existing data, with the aid of computers, had now become readily accessible to administrators. But they decided that at present most of the questions asked of the data had been "short term," that is, questions for which there was a great and immediate demand, but which were not necessarily the most important. "Long term" questions, those that might not have an immediate use, but which might be of considerable value, are not being asked. The resultant situation is one where the computer provides information quickly, but not the sort of information which helps the administrator change his behavior in any significant way.

The notion of what sort of questions to ask became crucial to the discussion. The participants agreed that no piece of data is inherently trivial or inherently important unless it is used in the service of some question that is asked, but they felt that they did not know what kinds of data would be needed to be gathered to help in decision-making at the administrative level. The participants felt that there should be the building up of systematic analyses of the kinds of decisions administrators have to make, especially to help deal with various aspects of decision-making in terms of what happens to people. They saw too that because of the considerable amount of money being put into education at the present time, a new order of administrative decisions, particularly with regard to allocation of resources, is confronting administrators, and that unless these administrators can respond with some kind of definitive answers, the decisions will be made by other segments of society who may not have any more evidence to make the decisions, but who would nevertheless repudiate the administrators' unsatisfactory attempts.

The participants felt that what was needed most was a conceptual framework or model of quality, or efficiency, or productivity toward which an administrator might strive and on the basis of which some hypotheses might be drawn. J. Alan Thomas particularly felt that these theories or models were actually prerequisite to the use of data banks for improved research in administration, because they would provide some sort of rationale for the collecting and ordering of data. The models would be able to indicate the kinds of administrative and non-administrative variables that exist, as well as the relationships between them, and the kinds of decisions an administrator has to make in order to improve the total productivity of the organization.

To many of the participants this seemed more sensible than indiscriminate absorbing of all kinds of data, but others warned that certain kinds of data might be overlooked just because there wasn't a theoretical framework which encompassed them, and that the potential of a data bank would be decreased by so sharp a focusing on a particular kind of data. They felt, too, that the time dimension was important, in that even with the conceptual framework, provision needed to be made for enough questions to be asked so that it would be possible to get longitudinal studies that would be of value. Robert Dreeben suggested that a new set of questions be asked periodically to be utilized as information additional to the central body of information which is collected continuously, and that a new study or a new theoretical scheme be used to conserve a new particular set of interests.

Recognizing the intricate milieu in which the administrator works, Thomas suggested that those administrative hypotheses tested must take into consideration some of the complexity of the administration of the school, which means that the school has to be considered as a system with various inter-relationships among people and the total environment. The participants felt that if this systems approach is accepted, then the conjunction of computer and research in education administration might most profitably be in the area of simulation studies. Such simulation procedures would make it possible to arrive at such things as the relationships between the allocation of a fixed amount of resources and the educational outcome obtained. The total systems approach would also permit such things as the simulation of different types of building and student flow, and the simulation of the value systems used in scheduling, in replacing or modernizing buildings and appointing personnel.

The participants generally felt that a data bank needed to have some level of acceptability by the personnel involved, and that there needed to be some sort of strategy employed to achieve the faith and cooperation of the people providing information for the data bank. The harassment caused by having additional forms to submit, or showing teachers the computer "hardware" seemed only to defeat the purpose. One suggested positive means included providing the local people with returns of immediate worth, as well as with indications of how the data bank was trying to deal with the important questions of education.

1-B Curriculum, Arthur W. Foshay, chairman

The participants experienced an initial difficulty in finding terms acceptable to all that could be used to describe various aspects of curriculum and the teaching-learning process. For example, there was difficulty in finding objective terms to describe, and especially objective items to test, such curriculum goals as "increasing awareness of the human condition." Arthur Foshay summarized the difficulty by indicating that there is not a satisfactory way of talking about what is taught, but that given the possibility of an educational data bank it becomes reasonable to ask for concerted efforts to develop terms that come closer to describing curriculum and the teaching-learning process, as well as the objectives all educators espouse and talk about.

John Goodlad, in a letter written to members of the curriculum committee, expressed his concern that until data are brought sensitively to bear upon the educational decision making process, we will continue to know very little about the desirability, the relative success, and the effects upon students, teachers, and the like of such things as new curricula, nongrading, and team teaching.

The notion that an educational data bank would be of value became the generally accepted premise for the group, and some of the discussion then centered around the ways it would be of value. The participants were concerned with such matters as diffusion of new materials, information about what topics are taught, and the emphasis, in terms of time, documents, and themes that each topic receives. Donald Oliver thus saw the educational data bank as showing curriculum specialists "what the lay of the land is." The participants agreed, though, that in getting this over-all view, educators would have to distinguish between the "straightforward" accounting-type questions and the "dynamic" research-type questions they would ask of students, teachers, and schools.

The accounting questions were seen as relatively easy to ask. Much of the resultant data would be simple descriptive information regarding such things as textbook use, and background information on teachers and students, and grades. The participants noted that much of this information is already collected by the schools or state departments of education, and that collecting it for a data bank would not place too great an extra burden upon the persons giving the information.

The research questions were those which the participants at first felt may not be immediately suitable for data bank procedures at the present time because of the difficulty in obtaining such information and because the categories which researchers are now using are so transient. Most of these questions would have to do with the act of teaching, and though the participants agreed on the need for this sort of information, they felt that researchers had not yet developed effective means of getting them. This immediately led to the suggestion that perhaps the existence of a data bank would encourage researchers to develop these means, as for instance in constructing new observational schemes, particularly suitable to data banking.

The participants made a special point of noting, however, that the distinction between accounting questions and research questions should not be drawn so finely as to imply that the accounting questions were of minimal value. Donald Oliver indicated that there was no reason why the accounting questions could not be used for research purposes such as then-and-now studies or achievement test and school grade correlations. Accounting information about textbook adoption would certainly help in identifying easily for the researcher those areas of the curriculum at the school, state, or even regional level, where certain texts are or are not in use. The researcher could then determine through other research methods whether, for instance, certain kinds of biased orientations toward educational material were operating.

Having established some of these uses for an educational data bank, and having explored some of the distinctions between the kinds of data that would be collected, the committee indicated some categories of information which in its view would be of long term value in dealing with curriculum questions:

Accounting information. Easily available from an entire region, easily coded and retrieved. (1) A list of published instructional materials in use, subdivided according to the portion of students using the materials and the school level at which these materials are used. The participants felt that only texts reveal a program of instruction well enough so that additional information would add to it significantly. (2) Background information on teachers, including such information as schools attended, subjects studied, length of time per subject, education positions held, sex, marital status, and number of children. (3) Demographic information on students, including date of birth, sex, length of schooling, father's occupation, father's education, education history (elective subjects taken), hobbies and interests, and extra-curricular activities. (4) Achievement tests results, including the use of an item sampling design in which a given test is spread out over several teachers and pupils so that each answers a small percentage of the items. The participants felt that achievement tests survey achievement rather than analyze it, and seek to report a kind of index number rather than a pattern of achievement. They noted that studies by Frederic Lord of Educational Testing Service have shown item sampling to be quite feasible even though it is at odds with the tradition of giving the same test to every pupil for purposes of fairness. (5) School grades as recorded locally. In addition to these five categories, it was recommended that locally published curriculum guides be microfilmed and stored.

Research information. Not as easily available but importantly related to the dynamics of teaching. (1) Students' descriptive statements on teachers' styles. (2) Teachers' logs of topics and intellectual thought processes. The participants agreed that very little is known about how individual teachers, or groups of teachers approach various topics, how much time is spent, what thematic associations are made, or what materials are used. (3) Observations of teaching styles and verbal content of classroom interactions. Arthur Foshay mentioned that even untrained observers can provide observations with considerable accuracy of such things as order of events, placement of teacher, and use of materials, and that utilization of such observers would make the gathering of this information feasible in the near future. (4) Other objective instruments, including aptitude inventories and tests of general mental process. (5) Teachers' ratings of topics and test items as either emphasized or as worthy for teaching. (6) Data concerning students drawn from school records relating to emotional development, social development, and health history.

The participants reiterated that the gathering of both types of information, and especially the research sort, would require not only extensive cooperation among all concerned, but would also involve ferreting out new ways of describing such things as new curricula, and teaching styles. They emphasized too, that the data bank should not be construed to be a file in which information was placed on one occasion, but rather, a continuous accumulation of up-dated information.

1-C Instruction and Learning, John B. Carroll, chairman

The participants addressed themselves to the kinds of data that might usefully be employed in an educational data bank in order to study processes of learning and instruction. There was general agreement in the first place that the primary use of an educational data bank would be to provide base line detail for keeping track of the whole education enterprise. It was recognized that the notion of a "base line" is essentially artificial insofar as there is always at any given time a very large variation in the quality of instruction, in the kinds of curriculum, innovational and educational practices that are in use at any given time, but even with this variation it was felt that it was still possible to make useful studies to report on the state of education at any given time.

For this purpose it would be necessary to classify the variables generally into three categories: learner variables, task variables, and situational variables.

The first class of variables would include such things as subject matter attainment, time spent in learning (consisting of such factors as rate and amount of learning, amount of retention, and time to re-learn), types of learning, and relationships between aptitude and achievement. Also present would be such variables as student interest as indicated by such things as self-initiated work, career and course selection as well as progress toward the student goal.

A second class of variables to be incorporated in routine data collection may be called task variables--that is, the information as to the particular tasks of the learner in all areas of school curricula. Obvious variables to be included would be tabulations of curricular choices, methods of teaching, curricular content, use of special instructional methods such as audio-visual aids, program instruction, and language laboratories. There should be precise information on the amount of time devoted to various topics in the curriculum so that this information can be correlated with pupil characteristics and subject matter attainment. Essentially, what is required are characteristics of the curriculum that the student goes through such as its organization, the diversity of course offerings, the sequence of courses, the space between similar kinds of subjects, subject matter learning and opportunities for review regarding learning and outside education. (See the report of Committee 1-B, Curriculum.)

A third class of variables would be situational, including all those that affect the course of learning. Most important here are the whole range of teacher characteristic variables such as teacher knowledge, preparation, attitude, teaching style, cultural background, and teaching experience. Also included would be variables pertaining to classroom organization, pupil grouping, the scheduling of classes, and the organization of teaching (team teaching, etc.), facilities and special education.

It was recognized that even the requirements of a data bank purely for base line information and analysis are very demanding. It was suggested that the existence of a data bank might force educational research workers to develop better standardized instruments for measuring pupil characteristics and attainments and the other variables which have been listed above. In this way base line studies would provide a standard of comparison by which the effects of educational innovations could be evaluated. It would also make possible the selection of examples with defined characteristics for special research studies on particular innovations or procedures that might be proposed.

It was emphasized that modern technology would enable the data bank to record and store information at almost a microscopic level of detail. This would be desirable so that the evaluation on which data are accumulated could be studied in various combinations. For example, the recording of item responses rather than total test scores was recommended.

In addition to base line studies, the importance of longitudinal studies made possible by data banks was emphasized. On the one hand it would be possible to study pupil growth in a way never before fully realized. At the same time it would enable educational research workers to trace variations or trends in the quality of education over the years.

Many of the variables which we would like to study are still difficult to quantify, and further efforts will need to be made to improve or refine measurement procedures. There is also the problem that although certain variables are readily quantifiable, there are various forms of social resistance to the obtaining of such data. Nevertheless it is possible that these areas of resistance can be reduced when it is demonstrated in certain regions that no harm or disturbance is actually created by the collection of these variables.

While the emphasis on base line data provides information with respect to present existing practices, as schools change, different kinds of information for a data store would seem to fall into such classifications as the following:

1. Base line information, as emphasized
2. Indication of change and variation in base line information
3. Variations in school outputs of various kinds so that these can be correlated with existing situations
4. Limits of educational growth; by this is meant information on the maximum possible levels of educational attainment that can be exhibited by pupils of a given range of aptitude, cultural background, or environmental experience

5. Instructional conditions; to describe this, standard rubrics would have to be developed, with some common meaning so that conditions such as lecture method, discussion, programmed instruction, could be specifically identified.

There was considerable discussion of the desirability of recording in the data bank, as much as possible, information on what actually goes on in the classroom. It was suggested, for example, that such data can be obtained directly from students by questionnaires and similar techniques.

Discussion also emphasized the utility of a data bank for the assessment of learning and instruction utilizing multiple outcomes rather than single variable assessments.

Another feature of the data store that might be useful for researchers was some indication of indices of resistance or amenability to change that could be identified prior to experiments in a school or school system. This is part of the obtaining of general information about a sample of schools that a researcher might require to characterize or select the population he is interested in using, and would enable him to select his experimental groups with good controls.

1-D Research Methodology, Julian Stanley, chairman

Much of the discussion about research methodology centered around the problem of whether research should be "built into" or "grafted onto" educational data banks. The latter solution exists when the data bank is used by people who have not participated in the formulating of the bank and who come along at some later time to see what sort of research studies they might make with this vast amount of data, or to see if it can answer some question they have decided to pose long after the data had been collected.

Julian Stanley referred to this retrospective analysis of data collected for purposes other than for what the researcher intends to use it, as the real dilemma of the data banks. E. F. Lindquist maintained that the business of collecting data and then of laying it in front of a worker and saying, "Here are the data; find the problem and make something out of it," may not yield quite as good an answer as some seem to think. And in general, the participants felt that substantive researchers actively concerned with problems and hypotheses should help design educational data banks, not leaving entirely in the hands of the methodologists and school personnel the specification of variables to be included.

Even with such provisions, the participants still saw some problems that would attend the establishing of data banks. One of these involved the matter of data analysis separated by some years from data collection. A few of the participants expressed some uneasiness about including in a data bank only those items related to the present needs, yet they saw, too, that it would not be feasible to plan for all possible research contingencies or to attempt to provide an "all-purpose research kit" that would answer all conceivable questions for all conceivable institutions for all conceivable levels of students. The ideal situation would be one where variables could be placed on a continuum of certainty as to their future significance, but in reality, researchers can only surmise what sort of information will be useful ten or fifteen years from now. The participants stressed the importance of looking into the future and trying to decide what researchers will want to do with certain variables many years from now.

Another problem considered was that of knowing how much data to save. Lindquist indicated that data banks needed to refine and summarize the data they had collected, reducing detail to meaningful indices, rather than storing every single bit of information spearately thereby causing the whole situation to be unwieldy. Others, admitting that the retrieval of stored material from magnetic tape is currently very time consuming and expensive, and that the theory of data retrieval is now poorly developed, felt that better retrieval techniques will be forthcoming, and that therefore second thought should be given before discarding such things as item responses.

The participants recognized that sequencing the collection of items throughout a student's school experience for longitudinal research is likely to be troublesome, not only because of such factors as the mobility of the population, but also because there is the problem of trying to decide which data to collect first. Attention was also given to the inter-translatability of data collected by various regional data banks, and N. L. Gage suggested that the making of comparisons of the relationships between certain variables in one region with the relationships between these same variables in another region requires that the variables be measured in comparable ways in both regions. Such research uses imply, and indeed, necessitate that there be some sort of connection between data banks.

Data banks were seen as forcing new approaches to educational research because of the availability of large bodies of complete and quickly usable data. Simple correlation techniques were seen as no longer really adequate to cope with the increasing wealth of data, but multivariate techniques such as factor analysis, discriminant analysis, and canonical correlation were suggested as means of getting the most out of the data.

Stanley warned about trying to do pseudo-analyses of covariance by "partialing out" the influence of variables not antecedent to the "independent" variable being studied (such as size of class). One might thereby "throw out the baby along with the dirty bath water." Teasing of causal inferences from associational data is no one-shot, simple matter, as has been learned from the prolonged controversy about whether cigarette smoking causes lung cancer. It is all too easy to dignify *ex post facto* analyses and even pseudo-experiments by calling them "quasi-experiments." "Patched-up" designs probably require even more planning and careful analysis than do "true" experiments, defined as those experiments where the experimenter actually assigns the experimental units to the manipulated-factor-level combinations randomly.

1-E Student Development and Personnel Services, David V. Tiedeman, chairman

The participants considered three areas which they believed have bearing on the problem of developing and using a data bank. These areas included (A) Methodology, (B) General questions of current interest, and (C) Principles which should guide the organization and operation of a data bank.

A. Methodology. Paul Lohnes read a paper[1] entitled "Data Bank Support of Student Development Research." Lohnes specifically argued the possible value of the Markov chain as a stochastic model possibly representative of student abilities which provided the means of transforming relative frequencies of a set of people characterized in their condition at an early time, into a second condition at a later time, thus providing a means of determining whether uniformities exist in transitions or not. Lohnes suggested that this model might be useful in studying questions about educational and vocational choice. The model presumes that the later condition has a scale similar to the earlier condition, so that there is a logical extension in meaning from the first time to a second time. Since this is not likely to be the case in educational choices which become transformed into vocational choices, Lohnes suggested that it might be possible to use the Markov chain model within a stage of vocational development, while it might be impossible to use the model across several stages of vocational development.

If the Markov chain model is to be put in use, Lohnes noted that the following three conditions should hold in data which are banked:

1. It should be possible to secure probability samples
2. Long-term, short-interval longitudinal data will be needed
3. Extensive measurement and census information is likely to be required.

B. General questions of current interest. The participants resisted the stipulation of variables to be incorporated into a data bank because such actions would imply that questions now current in their minds would determine the information in the data bank. It was therefore suggested that textbooks on individual assessment might be consulted for lists of information at a time when it became necessary to specify the information for the bank. It was further suggested that Project TALENT had already created an extensive list of information about students which was of use in studying the interaction of pupils and education. The participants felt that the procedures of Project TALENT should be consulted when it became necessary to bank information on student development. It was also noted that E. F. Lindquist would have made decisions of this nature as he expanded his Iowa Educational Information Center.

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[1] The full text of Mr. Lohnes' paper is included in Appendix B of this report.

Despite the general reluctance to specify problems which a data bank should be organized to illuminate, Donald Super noted the general power which his variable of planfulness had with regard to the later vocational development of persons whose planfulness was assessed in ninth grade. Frank Field and David Tiedeman have also been interested in purposeful action. The incorporation of an interest in the variables of ego process into a data bank is likely to provide variables which will be very useful in considering the growth of liberation through education. Ralph Berdie noted that the University of Minnesota presently had an extensive bank of data of relevance to the problems of educational and vocational choice. The bank is accumulated on the supposition that its availability will attract people interested in research. The bank has already had this effect because several studies have been done on interest and personality patterns in relation to educational and occupational choices.

C. Principles. The participants decided that their time could be spent best by delineating several principles which might be incorporated in the organization and operation of a data bank. These principles are:

1. A data bank will create a force which will tend to make its variables of great concern in the research world. Unless guarded, this force can inhibit test development. The participants humorously entertained the possibility that the bank might be dissolved every ten years. One of the members noted that the bank provided unprecedented opportunity for research and that this opportunity made it possible to discard tests earlier than might ordinarily occur. This concept was introduced in order to indicate more fully the dilemma which would face the guardians of a data bank as they decided on the variables to incorporate in the depository.

2. It was remarked from the history of science that the data which had been most valuable over the years of development in physical science were those which were most accurate and most closely approximating naturalistic observations. It was therefore suggested that data for the bank be selected with this in mind. This principle may make it difficult to deal with banked phenomenological information, though perhaps it could be banked in relation to some of its operations as well as its impressions.

3. The participants noted that a data bank which was organized in conjunction with an educational data service would face the problem of confidentiality. Some members suggested that a data bank would need to be organized as an independent research organization such as Project TALENT because of this difficulty. Other members of the group did not think that the problem of confidentiality led to the necessity for such distinctiveness in placing a data bank in a research organization rather than in a service organization. In general, however, it was believed that the trustees of a data bank must continuously evaluate the problem of confidentiality of the information banked.

4. The participants were concerned that the bank would have a hardening of its assets and would not involve allotments for risk capital which would incorporate variables of potential usefulness which were not clearly delineated at the present time. It was noted that data of this kind might be incorporated more on a sampling basis than on a population basis. Furthermore, it was suggested that the trustees of the data bank would have to be careful in order to prevent the existence of the bank from hindering unknown innovators from getting access to sources of data in schools.

5. It was suggested that data which were banked ought to have a reasonably defined target population.

6. The participants felt that the trustees of a data bank need to be selected with care. These trustees will determine what is banked and it is important that they have the trust of the professional community with regard to such decisions. The trustees will also be faced with decisions with regard to the ethical use of data in the bank and the social justification for individual uses of the bank. Therefore, the trustees should be encouraged to publish guidelines and to justify their decisions as they go on, in order that the operation can be reasonably public.

7. It was stressed that the data in the bank should, in general, be longitudinal in nature. The participants expressed preference for longitudinal data over cross sectional data. It was noted that the data in the bank should extend beyond the school period. (In the discussion of the difficulty of following up students, it was suggested that students be informed, while in school, of the value of such investigation so that they might be more inclined to participate. Furthermore, Alexander Astin noted that the existence of a data bank made follow *back* study possible. Astin also noted that this possibility meant that information banked should pay attention to the problem of band width as well as the problem of band fidelity.) The participants stressed that the criteria banked should be broader than school grades, but no specific suggestions were made concerning this broadening.

COMMITTEE REPORTS: PHASE TWO
(TYPES OF RESEARCH DATA)

Later, the participants were regrouped for Phase 2 of the conference in order to focus their attention on particular types of data that might be accumulated in educational data banks. The committees were:

2-A Demographic Data (age, sex, socio-economic status of parents, and other data which are essentially sociological), James E. Coleman, Johns Hopkins Institute, chairman.

2-B Descriptive Data (class size, pupil-teacher ratio, and other summary statistical data which describe characteristics of the school or the student population, personnel, etc.), David G. Ryans, University of Hawaii, chairman.

2-C Evaluative Data (tests, student grades, and other data for evaluation of student progress, teacher success, curricular validity, etc.), E. F. Lindquist, University of Iowa, chairman.

As with Phase 1, each chairman presented a report, in a plenary session, on his committee's discussion which was then subjected to comment from other conference participants. The following are summaries of each Phase 2 committee meeting.

2-A Demographic Data, James E. Coleman, chairman

The participants felt that the education data collected today fall into two classes: those which are collected specifically for research purposes, and those which are collected as part of routine administrative activities. They felt that the principal concern in data collection need not be with specific studies in which the data are gathered for research purposes, but rather, with administratively gathered data where attention has been given to the contents and comparability of the data. It was particularly noted that a considerable amount of the data that are gathered in routine fashion is researchably useful, and that the schools did not feel overburdened in providing this information since it is part of an existing wide range of data which derive from the administrative needs of the districts in justifying expenditures.

The major part of the discussion centered around three areas: existing systematic data collections gathered at the level of the school or community; existing systematic data collections gathered at the level of the individual; and principles to govern data collection, plus optimal means of obtaining data.

With regard to data collected at the level of the school or community, which include information about the sizes and types of buildings, the organizational structure of the system, the numbers of students, teachers and the like, various projects were mentioned that have utilized this sort of data. The Metropolitan School Study Council in 1940 and 1956 gathered a number of socio-economic variables of the school districts, and analyzed these in relation to school outcomes. In another study, J. Alan Thomas used data such as family income and amount of education, and determined what percentage of the variance among the mean scores of a number of schools on certain Project TALENT sub-tests could be explained by general community characteristics, resource inputs, and administrative decisions. It was also noted that some studies have been "one-shot" projects carried out by state departments of education or local school districts for specific purposes.

Existing systematic data collections at the level of the individual were exemplified by such activities as the three national programs relating to college entrance, College Entrance Examination Board, American College Testing, and National Merit Scholarship, which systematically collect data on all students who take the tests. The participants indicated, too, that students from various different systems throughout the country who take the same standardized tests could certainly be placed in a national data bank of students, and that standardized scoring of tests would aid in making connections between the data on each student. It was noted that much information such as occupation and education of parents comes as a result of state-wide testing, and there was general agreement that, although this sort of data collection ordinarily occurs only at one point in a student's career, the testing programs probably represented the only systematically comprehensive data collected. Another example given was the Basic Educational Data Systems which has resulted in all states collecting comparable data such as age, sex, degree held, salary, experience, and kind of certificate on each teacher in the state system, and which is producing, among other things, a nation-wide bank of data on all teachers from which samples may be drawn as the need arises. Another national project, sponsored in part by the Office of Education in connection with civil defense efforts, collected data such as the number of classrooms, the type of construction, and the number of adults present for all school buildings in the country. It was mentioned also that an aircraft company in Kansas is offering a service to local school systems for keeping on magnetic tape student records, including background, achievement, ability, and other kinds of such information that students accumulate during their school years, thus making possible the comparability of records on those schools which participate in the service.

The discussion next turned to the principles that should govern data collection, and Ralph Berdie offered nine considerations he felt to be important.

1. The collection of data should not harm the student. It was noted that there is much objection to personality inventories being given to students.

2. The collection of data should not disrupt the community.

3. The collection of data should not hinder future research.

4. The maintenance of records should not harm the student.

5. The reliability and validity of data should govern the types selected. There was general agreement that test-retest reliability was essential, and some felt that a variable should "earn its way" into a bank by having shown its relevance.

6. Data should be included only if one has hypotheses in mind which relate them to education outcomes.

7. Variables should be tied directly to behavior. Some participants agreed that such things as self-ratings, though supposedly a verbal behavior, would not be of too much value unless certain kinds of self-ratings could be found that were related to other observable behaviors.

8. Variables should be of known stability. There was some resistance to this restriction since a number of participants felt that one primary objective of education is to make unstable behavior stable, and that the problem in education is knowing how a student moves from a point of instability to a point of stability. It was noted that it would not be possible to know whether objectives were being achieved unless one had the instability factor to work with.

9. The ease of data collection should be an element in decision. Thomas noted, though, and there was general agreement, that the kinds of data easily obtained are not necessarily those kinds that are theoretically useful.

Lorne Woollatt suggested that a variable should be related to the quality of education, and that a variable should have a very small relationship to other variables related to this outcome of quality of education. This last point, though, found disagreement among a number of the participants who felt that even though two things were highly correlated with each other they could still be very differently related to a third variable.

The final topic of discussion concerned the optimum means by which data might be obtained. Among the suggestions were that state-wide testing programs be used as a point of entry into data collecting in the schools, and that full utilization be made of the annual or biennial census of children that some states and districts require. The participants stated, too, that regional centers such as New England Education Data Systems would make possible the future comparability of data across systems.

2-B Descriptive Data, David G. Ryans, chairman

The participants first attempted to set up certain distinctions between demographic, descriptive and evaluative data, and finally decided that descriptive data were those data which related to the organization of the school and to the behavior of the school as an organization. Descriptive data thus were concluded to be such data as are relevant for school processes and operations as distinct from data describing other environmental conditions.

On the basis of this definition, the participants discussed the purposes of data banks as implied by certain classes of data which they felt to be descriptive. Included were data used for accounting, research, operational, and decision-making purposes. But it was seen that such categorizing of data was misleading since a particular variable might be used for any one, or all of these purposes. This feeling led to the statement that the real consideration was not so much a particular class of data as it was a particular class of questions asked of the data, and that data banks would develop their characteristics and purposes as a function of the user.

Nevertheless the participants felt that there needed to be some listing of the possible variables that might be included in a data bank. Paul Lohnes suggested two categories of variables: (1) overt, the reliability of which could be checked easily, and which would include such items as health problems, divorce, separation or death in the family, attendance, and criminal convictions, and (2) covert, which would be articulated on a free response basis by the student making statements about some particular aspect of his situation, and which would be coded and made usable by some sort of inquirer technique. John Alman suggested another categorization which would provide a complete description of the curriculum in some generally codeable and recognizable way, a description of the physical plant facility of the school, a description of the instructional staff, and a description of the student population.

There was a general feeling that these categories might be subsumed by the classification of variables as presented in the report of the conference committee on Instruction and Learning. These included task variables, learner variables, and situational variables, or any variables, as suggested by Arthur Foshay, "which involve students learning some thing under defined circumstances, in some defined time and place." It was felt that these variables did indeed constitute descriptive data of the kind presumed to be considered by the participants.

Task variables included were: procedures involved in teaching and learning; learning content (topics, sub-topics, and organization of content).

Learner variables included were: abilities of the learner, including cognitive variables, psychomotor variables, and the like; readiness of the learner for specific kinds of information or learning; learner affective sets including emotionality, and attitudes toward subject matter and school; learner behaving styles; learner "progress-in-school" variables such as grades, progress toward some goal, rate of learning, retention and transfer; use of free time; peer group; memberships maintained and memberships initiated; statements of goals; learner problems, including health, family attendance, and anxieties.

Situational variables included were: institutional climate; district or institutional policies; community conditions; physical facilities; media available and used under various conditions. Other situational variables were grouped under the general rubric of instructor variables and included: capacities and abilities (cognitive, psychomotor); affective sets including attitudes, values, health, beliefs, and emotional stability; behaving styles; teacher roles; teacher strategy.

Ellis Page noted that there are certain data of the school that are descriptive and which are routinely being generated and collected, thus raising the question, as more and more data accumulate, of whether these data should be stored or destroyed. Some of the participants felt that all the data should be kept since retrieval techniques would soon become more sophisticated, and would therefore make massive storage possible, but others felt that the best procedure would be to keep item responses and the complete protocol for samples of the population, rather than for the whole population itself. The feeling was that a properly constructed probability sample could certainly provide the descriptive material about a representative group of schools or students which researchers needed, but that it would be important that the details be kept.

This feeling that the "total collection" approach was not necessarily the most efficient from the standpoint of the needs of the researchers, led to the opinion that the best interests of the researchers would not be served by being considered the "poor relations" of the service oriented data banks. It was also noted that the researchers would have to forego many research possibilities if they agreed to work within the framework of service oriented data banks, which might not provide, for instance, the anonymity of the individuals who suddenly find themselves part of a study because data on them happened to be in the data bank.

It was noted that with regard to the problem of confidentiality, such organizations as the American Psychological Association have expressed concern over the whole problem of ethical standards in research,[1] and the participants generally felt that such standards needed to be generated for data banks, and that perhaps a committee should be established to see that the standards were maintained, particularly where data banks were collecting sensitive information on individuals.

2-C Evaluative Data, E. F. Lindquist, chairman

The participants gave considerable attention to the question of whether data banks should be designed for service or research. E. F. Lindquist felt particularly that data banks should have as their principal object the collection and feeding back to the schools, information needed for decision-making and important operational purposes in the normal conduct of the schools, and that the schools participating in the collection of these data are not going to be highly research minded and are not going to be inclined to devote a great deal of time to the collection of data that may be of great interest to the research worker but of no obvious and immediate value to schools in conducting their own business.

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[1] Dr. Nicholas Hobbs, President of the American Psychological Association, has initiated a project, now in the formative stage, designed to produce a major revision of the Ethical Standards published by APA about twelve years ago.

Although there was general agreement that perhaps data banks had to start out as such service organizations, thereby establishing themselves financially and in terms of public image, and that some of the information collected will be highly useful for research, even though it was not planned with research applications in mind, there was some feeling that data banks needed to devote, nevertheless, a certain percentage--ten percent was frequently cited--of their input for research purposes.

Considerable discussion followed as to just how this ten percent would be gathered. Lindquist did not feel that items should be collected merely on the hope that, someday, someone will make use of them. He felt that the research worker needed to have a well-conceived questionnaire that fit the pattern established by the particular data bank, and that assurances be given that some follow-through would result from the collection of information. Other participants noted instances where 20 to 40 variables had been collected which were not involved with any of the hypotheses in any way. Such procedures, they felt, may not be the most cautious, but at the same time, they are not indiscriminate, and the hope is great that someone will find use for these data.

Some participants expressed concern that there would not be enough coordination among the data banks, so that data would be comparable from one bank to another. They felt that though every bank must maintain its own individuality with such things as its own central set of purposes, programs of tests, and methods of collection, care needed to be taken that researchers working with one data bank could make sense out of potentially related data in another bank.

One suggestion was that this comparability could be enhanced if information of the type collected through achievement tests, aptitude tests, questionnaires, inventories, check lists and the like, were preserved in complete detail, at the item response level, rather than at some more composite, highly processed level. The participants agreed that not all of this information would necessarily be available for immediate and rapid access in an electronic computer, but it was noted that some of this information might be preserved in the form of the original documents, or microfilm records of these documents, or in magnetic tape records that were stored but not merged or integrated with the data in the central bank.

The participants were generally reluctant to produce a list of items of information or types of information that data banks might collect for purposes of educational research, but some members of the group did indicate certain directions they hoped such data banks would take.

Lee Cronbach, David Tiedeman, and Donald Super expressed considerable interest in having data banks give special preference to collection of information that showed the development of a student's self-concept as manifested in reports of his present activities and interests, of his aspirations and goals, of his own evaluations of his achievement potentiality, of his attitude toward courses and course content, of his own conception of what the subject has to offer him, and the like. It was noted that this kind of information would have to be collected mostly in an interview or on some free response basis, and that to get this sort of information coded in terms that are comparable and useful for research would be quite difficult.

Even noting these difficulties, the participants did not wish to limit the input of responses to objective, precoded items, and Philip Stone indicated that automated content analysis applied to short compositions and other free responses had given measures of certain values and concepts, such as altruism, that were not being obtained from regular structured questionnaires.

The suggestions were also made that data banks should particularly attempt to record widespread adoptions of educational innovations; that data in the bank should have bearing on the objectives of the schools; and that data banks should be especially used in supplying the control data needed in the selection of special purpose, stratified samples about which further information would be independently collected by the research worker.

ADDRESSES TO GENERAL SESSIONS

A number of addresses were made to the conference during the general sessions, and served not only to provide a picture of the functioning of certain existing data centers, but also to call to the attention of the group at large a number of broad issues relating to data banks in education. The following are abstracts of these speeches.

E. F. Lindquist
State University of Iowa

The Iowa Educational Information Center

Address before the General Session
Friday, December 4, 1964--Abstract

The use of a data bank for research is incidental to its immediate practical service to the schools. Depending upon the rate of technological advancement, data banks for research will grow in proportion to the growth of their servicing functions. Research will be made possible by the availability of records which comprise data collected from several contiguous school years of the individual student. Using these cumulative records, researchers may make longitudinal studies of each student's development.

The Iowa Educational Information Center will collect information on individual pupils and members of the school staff, and on the curriculum, physical plant, and business operations of the school. The Center will store the information and build up integrated records. Using the collected information, it will service the schools by maintaining records, preparing reports and directories, scheduling classes, and by performing various other servicing operations.

In order to collect data, a new system, The Iowa Card Pac System, is being initiated. This system employs EAM type cards on which information is either pencilled or punched. These cards will be read by a scanner and the information will be fed onto a magnetic tape. A computer will then edit the information and will note those cards containing possible errors. Under this system, each student will have an identification number which he will not be required to remember. At the time of this speech, the Center is experimenting with a stencil card for each student which contains holes corresponding to his identification number. The student places the stencil card over the EAM card, and pencils in where the holes are punched. This stencil card will eliminate the necessity for prepunched cards for every individual student.

One problem is that of knowing what questions to pose in the student questionnaires. The Center is going to begin by giving the schools short questionnaires which will provide information for immediate use such as bus policy and districting. Once the schools become accustomed to the questionnaires and see the value of them, more research type questions can be added. There will be two parts to each questionnaire, one being the same from year to year, seeking information for longitudinal studies. The other part will vary from year to year and will itself be divided into two parts. One of these parts will be given to the whole student body and the other will be divided into units which will be rotated through the student body. The variable section of the questionnaire will seek information for one year research studies.

In order to acquire and maintain the cooperation of the schools in providing information, four basic requirements must be met by an educational data system. These requirements, which the IEIC seems to have met, are the following: (1) No school must be required to alter its present educational accounting practices or operational procedures, (2) The school must not have a perceptible increase in its clerical burden, (3) The services must be provided immediately and must be of significant value to the schools to compensate for their effort in cooperating, and (4) The system must, of course, be highly dependable and accurate.

Even though the State Department of Public Instruction compels the schools to participate in the providing of information, one of the most important things needed to be ensured in the establishing of an educational data bank is the cooperation of the schools. This can be done by giving them service through a system which is of great value to them rather than an inconvenience.

William W. Cooley
Project TALENT

The Data Bank of Project TALENT

Address before the General Session
Friday, December 4, 1964--Abstract

Project TALENT is an example of an existing data bank. Data have been collected on over 400,000 students from grades 9-12. These students had two days of testing in 1960. The last of the one-year follow up studies, which are conducted on each class the first year out of high school, is now being completed.

At present, Project TALENT is preparing a brochure to be distributed throughout the nation to potential users.[1] The object of the brochure is to let national scholars known exactly what kinds of studies Project TALENT undertakes and how the data bank may be used. Many people are not aware that the original ninth graders were retested in the twelfth grade and that this retest data is available for change studies.

Project TALENT has two types of data bank projects which it undertakes. One is research studies or investigations under contract. In this type, the Project TALENT staff drafts the design and specifications, analyzes the data, and prepares the reports for the study. In the second type Project TALENT merely performs specific analyses of data as requested by independent researchers and sends them the results. Project TALENT is very concerned with maintaining confidentiality, and for this reason, student rosters are not distributed.

One of the data bank projects which has already been done was a thesis at Stanford University. This project was a first start on a systems analysis of schools, the school being the unit of analysis. Of interest was the degree to which various sociological and economic characteristics of communities and administrative characteristics of schools can be regarded as predictors of certain school outcomes.

The federal government is very interested in national data banks such as the one at Project TALENT. An example of how Project TALENT can benefit the government is a series of studies done for the Air Force. The Air Force battery aptitude tests were calibrated against tests used in Project TALENT. Norms based on a national population of high school boys were then developed for the Air Force tests.

Another project which has been done is research on academic degree projections, sponsored by the National Science Foundation. Project TALENT data were used to provide projections of baccalaureate and doctoral degrees, to estimate talent loss in transition from high school to college, and to develop a taxonomy of colleges based on college characteristics as revealed by talent data.

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[1] Flanagan, *et al.*, 1965.

Project TALENT also conducted a study for the National Merit Scholarship Corporation in which National Merit finalists who participated in Project TALENT were compared with American high school students in general in regard to a large number of variables.

Another project was a study of economic attitudes sponsored by the Institute of Life Insurance. Economic knowledge was related to educational background and various socio-economic and curriculum factors to obtain data on factors influencing economic attitudes among high school students.

An important study being done at the present for the federal government is a study of the feasibility of ending the draft. This type of manpower study is extremely valuable to the government, and is the type of study which would justify government expenditure on this type of national data bank.

A study of early identification of behavior problems is currently being done in Knox County, Tennessee for the Public Health Service. Follow up data of particular behavior problems is now being obtained and project TALENT is now asking about the extent to which their battery can anticipate subsequent problems.

A sociologist in Chicago has certain hypotheses about the relationship of the masculinity-femininity variable to several sociological variables. With Project TALENT's hundreds of thousands of subjects, very large contingency tables can be used. Even though there is no masculinity-femininity scale in the Project TALENT data, the data will be rescaled to come up with this new variable.

An example of the follow back, another data bank use, is an assessment of a summer program which Project TALENT is able to do for the National Science Foundation. The National Science Foundation has sponsored summer programs for high school students during a period which would include students who were in the Project TALENT study. It is very likely that 5% of the students in the summer program will be found in the original Project TALENT sample. They will also be able to find students very similar to those in the program but not actually in it. Using this group as a control, Project TALENT can do studies which are more likely to assess the impact of the program than would a follow up of the participants alone.

Even though research may be an individual effort, the collection of data for the behavioral sciences is primarily a group effort. The Inter-University Consortium for Political Research issued a report in which reasons were given for having data banks. The report stated in effect that it is feasible that any data collection be viewed ultimately as the property of the entire academic community. Most social science data are not limited to the testing of a finite number of hypotheses devised within the constraints of a particular discipline. Historians, political scientists, psychologists, sociologists, and anthropologists can use the same basic data for quite different purposes. Furthermore, as new concepts are developed, prior collections can be reexamined in the light of new hypotheses.

Of primary importance in the specifications for an ideal regional data bank is the probability sample. Without knowledge of the target population, the collection of data would be a waste of time. A data bank should have a broad spectrum of data which includes specific data samples which would not necessarily be a complete reduction to currently desirable scales. Longitudinal data on individual pupils, staff, programs and finances, and comparable data from school to school should be collected. All these data must be capable of being linked; this is often not possible if data are not collected specifically for research purposes.

Charles Hall
University of Miami

What Data Banks Cannot Do

Address before the General Session
Friday, December 4, 1964--Abstract

The Biometric Laboratory of the University of Miami provides statistical assistance for psychiatrists and psychologists associated with mental hospitals who are doing research on psychotropic drugs. The Laboratory has accumulated files of data from these psychological researchers. The result is a "data bank" which may be drawn upon to investigate various research hypotheses.

There are three main shortcomings that the Biometric Laboratory has encountered which may be inherent in any data bank comprised of non-systematically collected data which is then used for research purposes. The first and most annoying shortcoming is lack of vital information. Certain data may be just what the researcher wants until he finds, for example, that the subject's sex is not indicated. Even if the information is not missing, it may be of no value to the researcher, for he may find scores on seven different I.Q. tests in seven different samples of the data, and that consequently the I.Q. information would be completely useless to him.

Another shortcoming of data banks is the limited or biased nature of the samples. This sampling problem is particularly relevant, for example, to NEEDS. Many school superintendents and school boards feel that automated data processing is not a necessity but a luxury, but they do not realize that automated data processing is less expensive in the long run. Thus, only those schools with progressive ideas and a fairly large budget are likely to subscribe to NEEDS, and therefore, the nature of the sample is necessarily limited. Because of the limited nature of the sample, experimental studies using the NEEDS data bank will be generalizeable only to NEEDS subscribers and will be quite useless to the general educational community.

The last shortcoming found in the use of the data bank for research is that the research must necessarily be historical, that is, it must be research under conditions which existed when the data were collected. Historical research can never answer a question such as what happens to students' test scores when we make changes in part of the school. Historical changes never occur one at a time; they occur in conjunction with other events. In one case, for example, a school adopted the ungraded primary system. At the same time, there was an intensive publicity campaign, including numerous meetings with the parents. The children's test scores did improve but there is no way of proving whether the cause was the ungraded system or simply the increased in parental interest. If there had been a controlled study with children under both the new and the old systems, so that the publicity campaign affected them equally, then the change in systems would be the only independent variable. It is hard enough to get these experimental conditions in the present. If the NEEDS data bank only accumulates data, it will never have any information in it except that concerning the curriculum from previous years and will not be able to answer questions of an experimental nature such as changes in variables affecting the teaching-learning process.

There are some positive aspects to data banks. The Biometric Laboratory, for example, assumes burdensome clerical functions and its facilities for collecting and collating data are of great value to the experimenter. Much real data are saved by having a well-trained central collecting agency. NEEDS can, for example, make the data collection process uniform, guarantee the accuracy of the data, and perform analyses with an expediency which will greatly benefit the researcher.

Data often can be used to study research methodology or to give an idea of what might be expected if a particular experiment had been performed. Data used in this fashion never yield experimental results but do frequently yield considerable information useful for the design or analysis of the next experiment. The only danger is that someone will become so engrossed in the methodology that he becomes convinced that the data yield sound experimental results.

Philip J. Stone
Harvard University

The General Inquirer Automatic Content Analysis System

Address before the Luncheon Session
Friday, December 4, 1964--Abstract

The study of human behavior requires, for its success, that there exist research instruments capable of dealing with the complexity characteristic of such behavior. Such an instrument is the computer which, being able to handle many variables concomitantly, relieves the researcher of so much technical drudgery that he is enabled to concentrate his efforts on the data, rearranging and viewing them from different perspectives. The power of the computer as a research instrument becomes particularly apparent when one attempts to study human beings through the analysis of their verbal behavior. To illustrate this power, I shall describe a system, called the General Inquirer, designed to permit automatic content analysis of textual material.

Basically, content analysis is the study of the frequency with which material occurs in a given text or group of texts, such material being, for example, reference to particular words or to categories of words. The procedures for content analysis require that the investigator specify what he is interested in looking for, and that he search the text--a task heretofore accomplished through resort to cumbersome manual procedures--for instances of the specified words, themes, or ideas. Through the use of the General Inquirer, a system of computer programs, it is now possible to perform content analysis with the assistance of a computer.

The General Inquirer System has the ability to read texts. Stored in large computer memories are dictionaries in which words occurring within a particular text are looked up and subsequently classified. Thus the researcher specifies his strategy for categorization of words by his construction of the dictionary he wishes to employ in the analysis. The search and labeling of the text becomes the job of the computer program.

The textual material is punched onto Hollerith cards which are then fed into a large computer--usually the IBM 7094, although this first phase can also be handled by an IBM 1401 with disc--in which the different words in the text are identified according to the scheme contained in the dictionary. A tape is written such that each record consists of one sentence, the identification code for the sentence, and a list of descriptor-categoreis that were found (in the dictionary) to apply to that sentence. After the words are looked up in the dictionary, and the tags (category labels) are associated with the sentences, a 1401 program outputs a list with sentences on one side of the continuous form and the tags on the other side. There are 1401 programs to provide total tabulation of the frequency of occurrence of the different tags. The computer keeps track of the number of times each word is looked for in the dictionary and periodically recompiles itself in such a way that the most frequent words are placed at the head of the dictionary list.

A great many studies have been conducted using the General Inquirer (see Stone, *et al.*, 1966) and I shall describe, briefly, a few of those which may have relevance to educational research in a data bank setting.

At Harvard, a study was performed using the General Inquirer system to analyze essays written by students as part of their applications for college admission. The investigators examined the students' college board scores and the predictions, which previously had been derived from these scores, of the students' academic achievement at Harvard. The essays of students whose achievement deviated from what had been predicted for them were selected for content analysis. The essays were examined to see if they reflected different sets of values and motives that might provide some clue to why these students performed the way they did.

Another study which utilized the general psycho-sociological dictionary of the General Inquirer was performed by Allan Ellis, also at Harvard. Ellis analyzed all Huckleberry Finn's direct discourse in the novel, *Huckleberry Finn*, in order to describe and better understand aspects of Huck's psychological orientation.

In the past three or four years there have been a number of different dictionaries developed around the country as part of particular research efforts to which the more general Harvard Third Dictionary was considered inapplicable. One such study, conducted by Colby at Santa Fe, consisted in the analysis of folk tales through the use of an anthropological dictionary. A political dictionary has been in use at Stanford University for the analysis of propaganda emanating from the Soviet Union and China during various periods of international crisis.

At the University of Chicago a dictionary has been constructed for the study of open end responses in survey-questionnaires, and at Yale University a paper has been written comparing four newspapers' editorials about the European Common Market.

The ability to handle all these different dictionaries enables one to make two kinds of interesting comparisons: a) one can see, by running different studies on the *same* dictionary, the relationships between vastly different kinds of data; and b) one can begin to understand, by running the same data on a number of dictionaries, which concepts are generally applicable and which are restricted to particular schools of thought.

Data gathering for survey research raises a problem which should be faced by any agency, such as an EDB, which collects data about human beings. The danger inherent in data collecting is the possibility of the data being misused in the future. Hysteria and centralized data collection are a bad combination. If there is no centralized data file, the process of the hysterical group getting target objects is a rather expensive one. If there are centralized data files, the hysterical group need not use the strategy of just getting a few sample objects. They can, however, cull and purge a whole subgroup with great efficiency.

While we can be very safe and secure today, the records that are created have a possibility of being very permanent. Care and thought should be uppermost in the minds of any group of people planning to collect large amounts of data on many human beings.

Benjamin Bloom
University of Chicago

Summary Remarks

Address before the General Session
Saturday, December 5, 1964--Abstract

One of the most important problems involved in the establishment of an educational data bank is that of knowing what to include in the data bank which might be of value to some future researcher. The responsibility will rest upon the creator of the data bank. He must have enough foresight to plan the method of finding the richest collection of material.

Another problem is that of the function of the data bank. Should it serve primarily as a service center or as a research enterprise? The hope is that no less than ten percent of the activities of the data bank will be devoted to research.

Another problem is the possibility that data banks may be used primarily for associational studies rather than experimental observational studies. Because of the comparative ease of the associational studies, the experimental attacks of educational problems may be neglected. Both types of studies should be done, and there should be a balance such that one does not drive out the other.

Another problem is the restrictive nature of the data collecting for machine use. It is hoped that ways will be found to use the machines to approach more complex problems. Even though not all educational research can be done using educational data banks, the data banks may permit us to attack complex problems of educational research in their full complexity rather than finding simplified ways of abstracting from a much more complex situation.

Another dilemma is that of individual research efforts as opposed to team efforts. There is a need for teams to plan the research enterprise in data banks. The individuals in the teams should be relatively young because they are open to new and different systems and models. Hopefully the teams will be interdisciplinary. There is a problem of coordination of the data banks because it is important that they be coordinated and at the same time maintain their diversity.

With data banks there is the danger that researchers may do studies by manipulating the data rather than by researching on the basis of new models or theories. Ideally data banks, instead, will stimulate new and different types of investigations. It is hoped that educational data banks may include cross-sectional as well as longitudinal research studies.

There are three other dangers that educational data banks present us with. One is the possibility that the data banks will siphon a great deal of the research money into their own use. Another danger is that the managers of data banks may pressure researchers to use their collection in order to justify the vast amount of expenditures. There is also the danger that data may be used by potential manipulators of society to harass individuals.

One hope is that educational data banks will develop over time rather than come into existence at a single time. With gradual development, each data bank will learn from the weaknesses and errors of previous data banks and will make an improvement.

The International Educational Achievement Study resulted from an interest in a cooperative attack on certain cross-national research problems on the part of educational research centers in various countries including the United States, eight European countries, Israel, Japan, and Australia. The data collected from this study consist of test responses as well as test scores in mathematics for 200,000 students from ages 13 to 17 or 18. In addition to these items of information, other items, such as interests, attitudes, and other biographical information on the student, have been collected. Descriptive data and teaching background information have been collected on the teacher. The researchers set up hypotheses which take advantage of the between-countries differences.

The countries have a right to their own data, and there is a problem as to how much data can be made available to other researchers. Because the IEA considers this availability very important, they have tried to document the material very carefully. It is hoped that this research study and the subsequent data bank will provide information that will be of great value to future researchers.

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Below is a list of the names and positions of the participants in the Conference of University Educational Research Specialists.

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Chapter 2

Proceedings of a Conference of Representatives of State Departments of Education

Because the development of a regional data bank was being considered within the context of the New England Education Data Systems, it seemed essential that the departments of education of the New England states should become actively engaged in determining the specifications for an educational data bank, especially since such departments are vital to the triadic relationship among universities, state departments of education, and schools. In view of this a number of representatives from the state departments of education in New England were invited to convene in Cambridge on May 26, 1965. Following are the names and positions of the participants in this conference:

Carl Bach-Wigg
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Edward Wilcox
Associate Commissioner of Education
Rhode Island State Dept. of Education

Summary of the Proceedings

The conference was opened by reviewing the prospectus of the Conference of University Research Specialists and some of the outcomes of that conference.

In opening their discussion, the participants noted that state departments of education have in their files vast amounts of information which they considered to be "generally available." But they admitted that the information currently being collected did not seem to be "paying off," since the state departments of education frequently still did not know what was occurring in the schools. It was also noted that with the increased amount of federal aid coming into the schools, it will be even more necessary to have great amounts of information on hand and that this information would need to have maximum usefulness.

The accessibility and retrievability of the information was seen as the most crucial factor in determining its usefulness, and though there was some skepticism about trying to locate centrally all the data possessed by the state departments, it was noted that there are increasingly sophisticated techniques for storing and quickly retrieving great amounts of data. It was felt that one way of making the task manageable would be to construct a computerized index of the various kinds of information available in a state or region so that initial inquiries about studies, systems, or states with particular characteristics could be made of the index rather than of the data bank itself. There was some feeling that though the states should not impose their will upon the districts in order to achieve uniformity in the reporting of information, the state departments of education should work toward uniformly reported data in order for the data, or the index, to be of maximum value.

The participants saw state departments of education as having policy-making, forecasting, descriptive, and research functions, and much of the discussion centered around the ways in which data banks could aid such departments in exercising these functions.

It was felt that data banks would aid in providing information for policy and administrative decisions, especially if information could be supplied in time to be useful for such decisions. Similarly, data banks would be useful in supplying the information and performing the analyses that would contribute to the forecasting function by making projections of such things as needed professional staff, materials, buildings, and the like.

With regard to the descriptive and research functions of the state departments of education, data banks were seen as having great potential use, especially as they took on the characteristics of clearing houses. The participants expressed interest, for example, in having computers scan the literature on research and on school law, thereby permitting quick retrieval of information about what projects had been done or were in progress, and what laws were applicable to a particular problem. Data banks were seen as keeping account of what sorts of educational innovations were taking place so that the state departments of education would have a more accurate and therefore a more useful knowledge of what kinds of educational changes were occurring in the school systems of the state. The participants also felt that data banks could provide a means of disseminating to the local systems information about research methodology.

The problem of gaining the cooperation of the schools received considerable attention from the participants. Some felt that there needed to be a purpose in collecting data, and in order to justify asking the schools for information, it would be necessary to have questions which would have real promise of producing results, rather than questions which would produce information that might only someday be of use. It was thought that the local school systems would need to feel that they were part of the enterprise and that there would be some value in their supplying information. Because the schools will want returns for their efforts, and because school superintendents would be reluctant to give information that is not going to be used, it was felt that the schools should receive analyses and reports based on the data obtained from them, and that the local school superintendents would be the deciding factor as to what sort of cooperation would exist. It was stated that it would take some effort to convince the schools of the idea of using for research purposes the data collected from them, but it was also noted that this should not be too difficult, considering the aura of respectability surrounding the word "research" today.

Because the voluntary participation of the schools in supplying information for the data bank produces a biased sample, any results obtained from studies using this data would be applicable, as some pointed out, only to the population represented by the data bank. But other participants indicated that schools are more alike than they are different, and that results of studies using data bank information would be generalizeable to a large population. Moreover, since there would be such full knowledge of the target population, it would at least be possible to generalize to similar populations. It was also pointed out that even though a data bank might contain information on many states and systems, it would still be possible for a particular state or system to extract information about itself.

The participants felt that wisdom did not reside alone in any one kind of educational agency--neither the universities, the local school systems, nor the state departments of education. This being the case, the educational data bank concept could have an important function in fostering cooperation among these agencies, even to the extent of encouraging a redefinition of some of their functions. Thus, the universities could go beyond their traditional concerns with the teaching-learning process and become more interested in the problems of administering education in the local schools and on a state-wide basis. The local school systems would be helped in their efforts to initiate and conduct research in cooperation with the universities and state departments of education. Finally, the state departments of education could reorder their priorities so that day-to-day administrative concerns would not go so far as they do now to impede the development of broad policies and research plans.

On the whole, then, the representatives of state departments of education were more enthusiastic about the possibilities inherent in educational data banks than we had any reason to expect.

Chapter 3

Proceedings of a Conference of School Superintendents

Central to the operation of any regional data bank would be the willing cooperation of local school systems. The local school system is where education takes place; the schools are, so to speak, "on the firing line" of the educational process. All educational researchers concerned with the operation of the school system (the public elementary and secondary school system, at least) must have ready access to local school systems and must interact with these systems by becoming aware of their problems, planning and conducting research with them cooperatively, and relaying to them the results of research.

Moreover, the local school system is interested in what is happening in other school systems, and it has many ties with state departments of education.

Those responsible for the present study of educational data banks felt, therefore, that it was of crucial importance to get ideas from representatives of local school systems concerning how they might relate to the operation of an educational research data bank. Opportunity to draw upon the expertise of a representative group of school superintendents was afforded by the convening in Cambridge of the Advanced Administrative Institute, a special institute sponsored by the Harvard Graduate School of Education, composed largely of school superintendents from various parts of the country. Members of that Institute were invited to take time off from their other studies to meet on July 8, 1965 to consider the problems of educational data banks. In all, 37 persons accepted this invitation; nearly all of them were school superintendents. They are listed at the end of this chapter.

Summary of the Conference Proceedings

Initially, a number of questions that typically arise in the operation of a school system were presented to the participants who were asked to rank them in terms of their importance to the conduct of education. Many of the questions involved day to day problems but the group felt that by far the most important questions were those which dealt with substantive issues in research in education.

The participants focused their attention on three general areas:

1. The statement and consideration of a number of research questions that appeared to be of most significance
2. The consideration of the accessibility through manual systems of the data vital to answer these research questions
3. General recommendations of the order in which these problems should be attacked in the future. The context of this discussion

was the data bank, and all considerations were made in terms of the ways in which an educational data bank could facilitate the needed research.

Questions such as:

1. What classrooms in the high school were not fully utilized this year?
2. For what certificates do the members of the school staff qualify?
3. Which students seem to have consistent patterns of absence?

were considered by the participants to be the questions of least importance.

Some of the questions which the participants proposed as ones they would like to see answered were:

1. Who are the underachievers in the school system?
2. What is the relationship between a student's success in the school system and his performance in college?
3. How do students in a particular school system compare with those from other systems on standardized achievement tests?
4. What are the factors most related to academic success?
5. What are the learning patterns of various ethnic groups?
6. In what ways is a particular experimental program successful?
7. What is the relationship between subjects or courses of study pursued in high school and the occupation the student enters after graduation?
8. What is the relationship between teacher effectiveness and years of experience?
9. What is the teacher tolerance for change?
10. What effect does the mobility of the pupil population have on the instructional program as reflected in, say, standardized test results?
11. What pre-school experiences best prepare a child for school experience, especially with regard to reading and motivation to learning?

The participants noted, however, that for practically every question considered to be of great importance, the data to answer the question were virtually inaccessible. It was noted that inaccessibility does not mean that data do not exist, but rather that the effort required to retrieve them or rearrange them manually would be so great that the data are, for all practical purposes, not at all accessible.

The feeling was that there are important questions to be answered, and that they are invariably of a research nature, but that in the large majority of cases the data to answer the questions are neither readily accessible nor in a suitable form for analysis. The participants felt that educational data banks managed by persons cognizant of the pressing needs for answers to these questions and technically competent to design appropriate research could provide a way of circumventing the great difficulties that now stand in the way of getting the needed research done. Indeed, the participants looked to educational research data banks to provide the impetus to an organized attack on the unanswered questions in education.

The participants felt, at the same time, that the schools can share in providing this impetus. Many of the schools represented had already taken first steps toward enhancing the accessibility of data by installing or utilizing various types of data processing machinery. The participants noted that such equipment is clearly a valuable tool for the routine administration of a school system, but they emphasized that such data processing and the resultant banks of educational data would be of greatest value when they could deal not with pupil accounting questions alone, but also with the research questions that were uppermost in their minds.

PARTICIPANTS

Below is a list of the names and positions of the participants in the Conference of School Superintendents.

John C. Albohm
Superintendent of Schools
Alexandria, Virginia School System

R. B. Allingham
Superintendent of Schools
Community High School District #88
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Carl Baden
Superintendent of Schools
Mariemont School System
Cincinnati, Ohio

Donald Baldwin
Superintendent of Schools
Ludington Area School System
Ludington, Michigan

Lester Ball
Superintendent of Schools
District 97
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J. Hartley Blackburn
Superintendent of Schools
Manater County
Bradenton, Florida

Paul Briggs
Superintendent of Schools
Cleveland, Ohio

C. G. Carlisle
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Tamalpais Union High School District
Larkspur, California

John J. Carnochan
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Frederick, Maryland

Robert Cawrse
Superintendent of Schools
Bay Village City Schools
Bay Village, Ohio

Kenneth Crowell
Superintendent of Schools
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Vernon H. W. Dessenberger
Superintendent of Schools
Oxford Area School System
Oxford, Pennsylvania

Willard Hancock
Superintendent of Schools
Yeadon School System
Yeadon, Pennsylvania

Willard Hawkins
Superintendent of Schools
Garrett County
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Joseph Hendrick
Superintendent of Schools
Hammond, Indiana School System

William Keller
Superintendent of Schools
Williamsville, New York School System

Philip Langworthy
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Douglas McGugan
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William Mahoney
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Loy Marshall
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Harold F. Martin
Superintendent of Schools
Upper Merion Township School System
King of Prussia, Pennsylvania

Howard Mason
Superintendent of Schools
Portland, Connecticut

Charles Northrup
Superintendent of Schools
Ossining, New York

Edwin Olds
Superintendent of Schools
Waverly Public School System
Lansing, Michigan

Truman Owens
Superintendent of Schools
Milford, Michigan

William N. Roman
Principal
Sudbury High School Board
Sudbury, Ontario
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T. Edward Rutter
Superintendent of Schools
Radnor Township Public Schools
Wayne, Pennsylvania

H. Curwen Schlosser
Superintendent of Schools
Upper Darby, Pennsylvania

William S. Schmidt
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Prince George's County
Upper Marlboro, Maryland

Harvey B. Scribner
Superintendent of Schools
Teaneck, New Jersey

J. B. Smith
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Dean Stoakes
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Fred Tanger
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Don O. Tatroe
Superintendent of Schools
Waterford Township School District
Pontiac, Michigan

Winston Wetzel
Superintendent of Schools
Missoula, Montana

Ross Willink
Superintendent of Schools
Rochester, New York

Charles W. Willis
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* * * * *

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Chapter 4

A Rationale for Educational Research Data Banks

The task we set ourselves in undertaking this study was to develop a basis on which to decide whether the concept of an educational research data bank is a viable one, and if so, how such data banks should be established, operated, and used. In doing this, we decided to elicit opinions and reactions from various parts of the educational community. Chapters 1 to 3 of this report recount the proceedings of a series of conferences, each addressed to a particular segment of the educational community, concerned with various aspects of educational data bank functioning. The present chapter attempts to summarize the results of these conferences and lay the groundwork for a rationale for educational data banks.

In holding separate conferences for each segment of the educational community--university educational researchers, representatives of state departments of education, and school superintendents--we had assumed not only that each group of participants would be concerned with problems unique to itself but also that it would be wise to keep the groups apart so as to eliminate problems of possible suspicion, friction, and misunderstanding among the seemingly disparate groups. It was thought, in addition, that there would be freer discussion within the separate groups if the other groups were not present. As we look back upon the separate conferences, we wonder whether our assumptions had been correct. In each conference, the participants not only showed similar degrees of warm enthusiasm for the idea of the regional EDB, but also expressed independently many ideas and proposals about EDBs that upon examination turn out to be identical or highly similar. It seems probable that if the participants from different segments of the educational community had been asked to meet together, they would have found wide agreement in their attitudes towards the notion of an EDB. We can approach any future confrontation of university researchers, school superintendents, and state department of education personnel with less trepidation than formerly. All these groups have common problems for which they believe educational data banks can make substantial contributions towards solutions.

In this chapter, therefore, we shall consider questions relating to educational data banks without reference to what we now recognize to have been a somewhat artificial separation of the various groups that we convened.

In reviewing the proceedings of the various conferences summarized in Chapters 1, 2, and 3, we discern that most of the statements and opinions made can be categorized in relation to four key concepts: *data, access, research,* and *cooperation*. How these words were used, and how their meanings can be expanded to enhance our understanding of the structure and role of educational data banks are the major concerns of this chapter. Both specific proposals of conference participants and our own expansions of these are cited. As mentioned in the opening remarks of the first part of the conference, the "nuts and bolts" of computer technology will be largely ignored throughout our discussion. Nevertheless, we do feel free to emphasize from time to time the technical or financial feasibility of certain suggestions which we fear might otherwise tend to be regarded as impractical.

DATA

A number of times throughout the conferences it was asserted that regional EDBs are likely to develop along the lines of the New England Education Data Systems (NEEDS) and the Iowa Educational Information Center (IEIC)--that is, as organizations which initially devote their energies to providing highly efficient accounting services to local school systems, but which then gradually expand their activities to include the facilitating of research to which their accumulated data, technical resources, and experience become relevant. This over-all pattern--although it does not preclude other possible lines of development, such as, for example, that of Project TALENT--recommends itself as inherently logical and practical. If local school systems are to be involved in the development and operation of an EDB, their involvement may often begin at a point likely to provide them relief from the pressing problems of record keeping and accounting. As the data bank evolves, then, accounting services would set the stage for research activities.

This eventuality, however, neither necessitates nor should encourage formulation of a rigid dichotomy between "accounting data" and "research data." These categories are often used to suggest two different strategies of data collection, or to impose an *a priori* limitation on the use to which a given set of data may be put. The misconception which often follows is that data can never serve more than one purpose. "The point is that much of the information desired for official state purposes *as well as research* develops naturally from local school operations." (Marker, 1965a). A particular variable may well be found useful for any one of, or for all, such diverse purposes as routine accounting tasks, longitudinal research, and administrative decision-making. Whether or not a given datum is of a particular "type," therefore, depends not upon any inherent quality of the datum itself but upon the context and form of its use. Grades in mathematics, for example, may legitimately be used for accounting purposes, for research, or for both, although we have no way of determining the appropriateness of such use until we know something of how the data were collected. The problems this fact poses are central to considerations of EDBs, and they are solved by reconsidering the universe to which the data of a regional EDB are applicable.

Tasks which are of an accounting type--report card production, school census lists, financial reports, teacher certification rosters, and the like--deal for the most part with complete populations. Every student expects a report card: in the context of report card production, it is therefore inappropriate to think in terms of samples. There is a statistical universe and it must be processed in its entirety. Research questions, on the other hand, ordinarily deal with samples. The requirement exists, however, that a sample be representative of the population about which generalizations are to be made.

Suppose, for example, that student X from Andrew Jackson High School received a grade of A- in advanced algebra. Naturally the grade would appear on his report card. Suppose further that we drew a random sample of students from this school which happened to include student X. If we were to make a frequency distribution of mathematics grades of these students, the same A- would appear again--this time in a statistical context.

There are two points made by this simple example. First, nothing about a datum marks it as being appropriate for accounting or research or any other purpose. We might do well, then, to avoid categorizing data with terms that might of themselves tend to inhibit a flexible, creative approach to data on the part of both researchers and other interested educators. Instead, we should consider the characteristic needs of potential users of the regional EDB--that is, the kinds of questions which they will ask of the data.

The second point to be made about student X's A- in advanced algebra is that the frequency distribution we would obtain from our random sample would, in fact, be representative of mathematics grades of students in that particular school. Thus, as long as we are willing to limit our generalizations to that universe of which our sample is representative, we are on firm research ground. If a regional EDB defines as its universe those schools that are its members, then samples drawn from its corpus of accounting data may be legitimate samples upon which to base research.

This latter point, elementary as it may seem, has a certain complex relevance to problems peculiar to the developmental phase of a regional EDB. The data base of a particular regional EDB will not suddenly spring into existence from some ideally representative sample of schools in that region. Project TALENT did, indeed, seem to spring almost overnight from an excellent sample of schools in the whole nation (Flanagan, *et al.*, 1965). But Project TALENT cannot be prescriptive of a data bank enterprise which involves ongoing contact with the providers of its data.

In short, regional EDBs will probably have to develop their data bases by working with *schools that are willing to cooperate with research efforts on a long-term basis*. Such voluntary cooperation on the part of a school necessarily suggests that it may not be representative of its sister-schools in the region. It may thus be a long time before regional EDBs can provide investigators large, well-defined populations from which to derive, without more than minimal recourse to weighting techniques, truly representative samples with adequate control groups. The broader implications of the cooperation problem will be discussed below. For the moment, let us simply recognize that there will be two major ways by which the data-base of a regional EDB will grow during the EDB's earlier developmental period: (1) by data gathered in the course of accounting services (which data need not be limited to accounting uses); and (2) by data from research projects, the results of which--to repeat the statistical truism which has already been mentioned--will only be generalizeable to the limited target population from which the samples were derived.

Virtually all the data generally considered appropriate input for an EDB are quantifications of information about students, teachers, or events relating to the conduct of education. Test scores and academic grades, for example, are attempts to reduce to a manageable form through quantification such information about the student--his grasp of a subject, the success with which he operates within the structure of a discipline, the extent to which he shows signs of generalizing to new experiences, and the like--as cannot readily be handled in the richer form of natural language. At present a numeral is used to stand for a wide array of statements that can be made

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about an individual's performance. This process of quantification obscures much that is relevant and often results in the separation of data from the context which gives them meaning. Techniques must be developed whereby original data in their full richness may be stored and manipulated in a natural language at a level that does not obscure the relationships among their constituent parts. This work can be done as part of data bank activities.

Much work, in fact, has already been done in the development of automated content analysis of structured or unstructured text material--i.e., questionnaire responses or continuous discourse (Stone, *et al.*, 1966; Simmons, 1963; Scheuch & Stone, 1964; Ellis, 1964, 1966; Smith, 1965). Since systematic quantitative description of the act of teaching and of students' self-concepts poses great challenges for researchers in the fields of curricular evaluation and student development, verbatim transcripts of such free-response situations as class sessions and guidance interviews may be envisioned as important kinds of input for EDB content analysis programs. Furthermore, state administrators consider desirable as part of a regional data bank such unstructured material as school laws and abstracts of important research; on the other hand, researchers--as well as administrators--require updated reports on widespread adoption of educational innovations. Efficient access to such large bodies of stored text could be provided by relatively simple adaptation of existing software (Bisco, 1964a).

But until refinement of retrieval theory and technique makes practicable computer storage of original protocols and responses, they should be microfilmed, indexed, and stored by the EDB, in order that at any time after collection and coding processing, accuracy of previously derived data may be thoroughly verified, and/or fresh sets of data generated from the original contexts but in light of new hypotheses.

The conference participants were generally agreed that computer technology could ultimately accommodate comprehensive, microscopic stores of educational data. Furthermore, there was some support for the notion that such an embarrassment of riches *ought* to be the eventual goal of advanced EDB data-collection and storage efforts, even if some or many variables could not be related at the time of collection to particular needs or theoretical frameworks. A less ambitious program of data acquisition, it was felt, might in effect restrict the interests of subsequent researchers to those of present researchers.

Nevertheless, the point remains that not even someone primarily concerned with future, as opposed to present, research possibilities, could now begin to implement a scheme for comprehensive, microscopic collection of educational data. Extrapolating from our own present interests, we can perhaps safely assume that future researchers will require not only refined, reliable measurement of a given variable (band fidelity) but also the opportunity to correlate many variables (band width)[1] (Astin, 1965). Thus, unavoidably projecting into the future our own fascination with multivariate longitudinal studies, we might well imagine as one of the greatest developmental challenges to be met by the regional EDB the creation of data collection and processing procedures whereby "information necessary and sufficient to the dual purposes of school management and longitudinal research reach unity" (Marker, 1965a). As might be the case with the development of natural-language storage techniques, work on such a uniform yet dual-purpose collection and praocessing technique could be done as part of the data bank's investigation of means to enhance its own usefulness.

Like that of obtaining samples which are representative of a region, the question of content- and format-comparability can be reduced to a problem of cooperation on the part of schools participating in the EDB. In short, if these schools submit to uniform accounting procedures, then the EDB can achieve comparable accounting data in its own region. It may be noted in this connection that a current pattern of cooperation between educational data-processing organizations in respect to systems design and development is a promising precedent for the achievement of comparability of data collected by different regional EDBs.

ACCESS

Operational definitions of the terms "educational data bank" and "data base" (SDC, 1964, 120) emphasize the concept of access because the utility of an extensive collection of data obviously depends on how easily a specified set can be located and retrieved for the user. The importance of access is vividly dramatized by the plight of the state administrator who regularly receives great masses of information from his local school systems, yet cannot quickly find all relevant sets of information within the mass in order to bring them to bear on pressing problems of administration, policy and forecasting, to say nothing of translating this mass into a meaningful general picture of the realities from which it has been abstracted. Likewise, the interested school superintendent is unable to attack important research questions not for lack of appropriate data but rather because of the prohibitive expense and difficulty of manual retrieval and rearrangement of those data.

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[1] Longitudinal studies regularly require "band width" along a temporal axis; that is, they are usually concerned with correlating many variables gathered over an extended period of time. However, to avoid confusion over these metaphorical terms, it should be noted that "band width" does not of itself imply temporal dimension, and that in a research context "longitudinality" properly refers only to time and not to the number of variables being studied. The loosely metaphorical term "panoramic" has been used to denote multivariate longitudinal studies; conversely, "snapshot" has been applied to studies which focus on relatively few aspects of a process for a relatively brief time (Carroll, 1965).

It is assumed that only the regular, systematic flow of data from schools into electronic storage facilities of a regional EDB will make possible the solution of such problems of access as those just instanced.

In the theory and practice of information retrieval, it is axiomatic that the more machine processes intervene between user's query and supply of data, the less specific may be the query, and the less formatted may be the data which are finally supplied (Bisco, 1964a). Minimum requirements of query-specificity, and maximum possibilities of free formatting should be posited as the most important desiderata for the information retrieval system of the regional EDB. Some features of the SPAN and Synthex systems, both of which were developed by SDC, are suggestive of how these specifications might be implemented in an EDB retrieval system.[1]

The primary application of the SPAN data-processing system, which is programmed for the IBM 7090/7094, is multivariate statistical analysis of an extremely high order of complexity. But the storage media and retrieval routines of SPAN are also very complex, with the result that the user is able to communicate with the system, and control its processes, exclusively by means of natural language statements. Complementing the user-orientation of the system are data files, each area of which is "intrinsically" or self-documented. In other words, stored in the file itself, along with the data, are descriptions of the file's logical and physical structure. On the one hand, this "intrinsic" structural referencing of each file allows efficient retrieval of any component section of the file, together with a capability to combine or to transform the data from a storage state into any other required state ("functional access"). On the other hand, this "intrinsic" referencing insures access to the contents of the file even though they may be undergoing evolutionary development ("logical access") (cf. SDC, 1964, 4, 120).

Synthex is an experimental computer system which is programmed to attempt to answer natural language questions by resort to the contents of a large children's encyclopaedia which has been read into, and stored in, its memory. For instance, Synthex can output, within about 30 seconds from query, a thoroughly adequate answer to the question: "Why is the sky blue?" The logic of the system involves: (1) indexing the content-words of the query; (2) expanding the meaning of the words by means of a synonym dictionary; (3) finding the smallest units of text in which the greatest number of content words and synonyms intersect; (4) scoring these units for the information they convey (by means of numeric values attached to content words and synonyms) in order to select the sentences or paragraphs which most resemble the question; (5) complex parsing and comparing routines which reject text statements whose content words or structures do not match those of the question.

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[1] The following remarks about SPAN and Synthex depend largely on Almendinger (1964) and Simmons (1963, 1964), respectively.

Both Synthex and SPAN have highly user-oriented retrieval systems, but the control statements which are used in SPAN are stereotyped, whereas Synthex--within the limits imposed by its text (yet even then not with great precision)--responds to natural language as such. The data-base of SPAN consists primarily of numeric symbols, that of Synthex exclusively of language. On the other hand, SPAN's data base is dynamic in that any given data file may be freely aggregated with any other, or with freshly input data (updating), or may be output in almost any kind of format. In contrast, the Synthex data base and output format are defined once and for all by the structures in which the data are input. The logical routines of Synthex are primitive in comparison with those of which SPAN is capable, yet the quasi-interpretative nature of Synthex' routines tends somehow to make a greater impression--at least, on a layman. And perhaps with good reason, since language would seem less logical, and thus more difficult for a machine to understand.

Our point in juxtaposing these two rather well-known systems is to suggest that the ideal retrieval system for an EDB with a large, complex and dynamic data base consisting of both verbal and numeric symbolism is conceptually not very far away. Would it not be a very fine thing indeed to have a system that could combine something like Synthex' orientation to users' own language with SPAN's powerful functional and logical access? If we did have such a system providing access to an EDB, then perhaps we might be tempted to posit still a third category of access, which would be a complex factor derived from user orientation, logical access and functional access.

We would call this derived factor, this third category of access: *psychological access*. It would be vaguely reflected in the degree of confidence of a potential user in the capacity of the EDB to provide him the information he needs. Or in a more operational vein, psychological access might be considered an inverse function of the degree of specificity with which the user must query the EDB retrieval system in order for the system to respond optimally in relation to what information in storage *might* be relevant to answering the query.

Once the data base of a regional EDB has developed over a few years, it might become very difficult for a researcher to find out what specific information the bank might have that would be of interest to him. In such cases, the ideal EDB system would analyze his question, determine which sets of its stored data could be useful in answering his question, and output a list of these sets (with a description of each set's logical structure) to the user, who would then be able to select the sets he wished to be retrieved *in extenso*. (This procedure, with its provision for initial and follow-up inquiries, in effect realizes the proposal for a "computerized index" made at the conference.) Or perhaps the researcher decided he wanted to see not any entire set but just two variables from one set and three from another. Then, upon specification at the input terminal of the intrinsic descriptions of each of the five variables, the system would retrieve and output them in any desired format or formats, e.g., parallel lists, continuous list, grid, punched cards, etc.

As has been observed before (Bisco, 1964b), the concept of access raises more than the problems of data location and retrieval, or of "confidentiality." For if access to general, non-confidential data is restricted to one group of educators or another, this restriction will necessarily limit the possibilities of the excluded group or groups to study the profession to which they are committed, and to join in efforts to strive to improve it. We feel that such restrictive practices would betray the cooperative premises inherent in the concept of educational data banking. In brief, in order to gain full access to essential data, the regional EDB must itself be fully accessible.

RESEARCH

Without research questions which an educational data bank would help to solve, the whole concept of such a data bank would be pointless. Yet, even in the conference of university researchers, it appeared to be difficult for the participants to spell out the nature of the research questions which would justify the establishment of an EDB. It is possible that the conference format was not the most effective one in which to elicit specifications or lists of research questions. Or perhaps the very diversity of the kinds of research questions whose solution could be facilitated by EDBs made it impossible to spell them out in any handy fashion like a Christmas gift list. It is of interest that the nearest approach to such a list was supplied not in the conference of university researchers but in the conference of school superintendents, a fact which reemphasizes the point that school administrators are likely to be unexpectedly receptive to the idea of an EDB as a facility for doing research.

What this section will attempt to do is to provide a series of categories for the kinds of educational research problems mentioned or hinted at by the participants in the various conferences held under the auspices of this project. Because of the fact that conference participants generally failed to come to grips with the specification of research problems, the authors of this report will attempt to round out the discussion by adding a number of their own ideas on possible research uses of EDBs.

A convenient classification of educational research problems can be made by considering them under four broad headings: (1) Measurement research, (2) Descriptive or status research; (3) Correlational research; and (4) Experimental treatment research.

1. Measurement research. Measurement research is concerned with the process of developing procedures and techniques for the measurement of the *variables* of interest in educational research. It is concerned, for example, with developing adequate (reliable and valid) measures of basic learning aptitudes, school achievements, and other characteristics of learners; it is concerned also with developing measures of the characteristics of teachers, administrators, schools, curricula, and other components of education. To a large extent, measurement research is *presupposed* by the establishment and maintenance of an educational data bank, in the sense that such research

would be prerequisite to the selection of the variables on which data would be obtained and maintained in the data bank. Generally, it would appear undesirable to collect and maintain data in a data bank on an unreliable or invalid variable.

It would be foolhardy to suppose, however, that all the variables that one might contemplate for inclusion in an EDB would be perfectly reliable and valid. The best standardized intelligence tests are not perfectly reliable, and there is considerable question as to their validity for various purposes. The collection and maintenance of imperfectly reliable and valid data in an EDB could eventually help not only in the further determination of the reliability and validity of these variables but also in the improvement of the measuring instruments on which they are based. It is immediately obvious that wherever possible, an EDB should maintain data on split-tests, alternate forms, multiple ratings, or similar multiple variables (e.g., item responses) that could help in the determination of reliability coefficients and standard errors of measurement. This would be particularly important if data banks are to be used for longitudinal studies, since such studies would require good information concerning the reliability of gains.

Further, procedures of test norming and standardization are central to the development of measuring techniques. Data banks could contribute not only to the establishment of local norms for tests and other measuring instruments, but also to the further elaboration of regional and national norms. Data banks should therefore be receptive to data obtained by means of relatively untried but promising instruments.

Among variables that conference participants mentioned as being in need of further development were: measures of teaching styles, observational measures of student behavior in the classroom, measures of students' "self-concepts," measures of students' ability or tendency to plan their futures, and measures of "underachievement." While the hard work of developing such measures would have to take place largely in the research laboratory itself, the data bank could facilitate the necessary measurement research on these variables by including them in appropriate subsamples of the populations they serve.

There is another sense in which EDBs could contribute to the development of measures, however, namely, by facilitating the development of composite variables arising out of data inserted into the data bank. Measures of educational growth of individual students or of quality of schooling could conceivably be formulated as complex functions of more specific variables recorded in a data bank, analogous to the index numbers and trend statistics developed in the field of economics. EDB data should be organized so that research in the development of these types of measures could be handled readily.

2. Descriptive, status research. This type of research is concerned with describing defined samples or populations with respect to specified variables. Descriptive statistics such as frequency distributions, means, and standard deviations are the chief tools for this sort of research, which

could also be concerned with describing developmental trends in terms of mean gains, standard deviations of gain scores, and the like.

The data bank is in its glory when it comes to descriptive research. The large quantity of data that would presumably be accessible for study would have to be summarized and characterized. The guiding hypotheses would stem from questions as to the status of a given sample or finite population. For example, one might concern himself with the mean and variance of achievements in a number of school subjects across a series of grades, or with the proportions of school dropouts that occur at various grade levels in a school district. Frequently the resulting statistics would be evaluated against either absolute or relative norms.

Although descriptive research is of a low order of sophistication in terms of scientific inquiry, it can perform important functions in the management of school systems, in the control of the learning process, and in the evaluation of the educational process in general. Availability of data banks would facilitate the kind of educational "accounting" that is contemplated by the Exploratory Committee on Assessing the Progress of Education, chaired by Dr. Ralph Tyler and funded by a grant from the Carnegie Corporation of New York; it would also have close relations with the Educational Opportunities Survey being conducted by the U. S. Office of Education in order to fulfill the mandate of Congress that the quality of American education be periodically assessed and that data bearing on the equality of opportunity in American education should be gathered.

All groups of conference participants recognized the need for this type of descriptive research in managing and evaluating educational progress, as they also recognized the facilitative character of EDBs in such needed research. Often the participants spoke of the need for "baseline" data collected in typical school systems, against which one could assess the effect of various educational innovations. For example, one would like to have available summary statistics on typical reading achievements in the elementary grades of a large number of school systems, so as to assess the possible effects of new reading programs that were introduced subsequent to the introduction of these new programs.

Similarly, the collection of longitudinal data on students followed throughout their school careers, frequently mentioned as an appropriate task for EDB researchers, could be regarded as falling within the category of descriptive research. From such data one could keep tabs on the average amount of achievement, from year to year, of individual students of various levels of ability. One could also gauge the limits of the range of achievement gains of individual students, sorted according to various characteristics such as age, sex, mental ability, etc. From this information one could make inferences as to the amount of educational growth that might be expected from students falling into the different groups. By adding data on student interest and motivations, types of curricular innovation, and other matters, it should be possible to apply the "model of the school learning process" proposed by Carroll (1963) and thus evaluate the quality of a total educational program. Comparative data on different school systems would enable one to estimate the role of various factors in educational opportunity and growth. (Actually, such a study gets into the realm of the correlation study, to be discussed below.)

If EDB inputs were properly organized, it would be possible, for example, very easily to construct the "academic inventories" proposed by Conant (1959) for assessing the quality of secondary school programs. These inventories, it will be remembered, had to do with the composition of the academic programs elected by the top 25 per cent of students in a secondary school. This is only one example of the kind of curricular analysis that might be made possible by properly maintained educational data banks.

Fundamentally, an educational data bank should be organized around the notion of improving the quality of education not only school-system-wide but also for the individual student. It must contain data on a variety of independent and control variables that might be regarded as pertinent to the study of educational progress, as well as a variety of dependent variables that would be regarded as suitable indices of this progress. One specific use of an educational data bank that was mentioned by school administrators in this connection was the identification of "underachievers." Although the identification of underachievers is fraught with many conceptual and technical difficulties (Thorndike, 1963), it is beyond doubt that the existence of a wide variety of data in a series of school systems would do much to facilitate the better definition of the concept of underachievement and on a practical level it could lead to better standardized and more valid procedures for identifying underachievers.

3. Correlational research. In educational research, the correlational study is one in which the associations or contingencies among variables are studied in order to (1) make inferences concerning underlying factors or components present in a series of variables, as in factor analysis, (2) suggest hypotheses concerning the causal relationships among variables that can be investigated either in experimental studies (see below) or in certain types of "quasi-experimental" studies in which temporal relationships permit inferences concerning possible causal influences (Campbell and Stanley, 1963), and (3) develop prediction equations that could be applied to future samples.

Here again, the data bank would be of very great usefulness in conducting research. The great variety of variables on which data would be available would make possible almost an infinite number of correlational studies. Indeed, the great temptation would be to use the data bank as a "happy hunting ground" for significant statistical relationships. It might often occur that "significant" relationships would be found merely by chance; the credulity or the ingenuity of the researcher would be stretched in order to make sense of the relationships.

Generally, it would be wise to enter and use a data bank for correlational research only where specific hypotheses had been formulated. For example, one might investigate the possible association of educational progress in, say, reading, with the particular textbook or basal reader series used, on the hypothesis that such curricular variations would be significant. At the same time, the data bank would afford greater opportunities than usual to find and use relevant control variables.

Nevertheless, it does not seem out of order to suggest that if sufficient prudence and care are exercised, data banks could be used for organized searches for relevant and meaningful relationships among variables that otherwise might be missed. In the same way that drug manufacturers have systematically investigated thousands of fungi and molds for their possible therapeutic value, systematic explorations of relations among variables relevant in the analysis of the educational process might turn up highly useful and provocative suggestions. For example, such a systematic exploration might have turned up the finding (Carlsmith, 1964) that the direction of the difference between Verbal and Mathematical subscores on the Scholastic Aptitude Test of the College Board is related to father absence during the first five years of life. This possibility would argue for trying to accumulate a wide variety of data regardless of its apparent relevance or lack of relevance.

Various conference participants suggested research problems upon which the diversity of data in an EDB might facilitate research attacks. School superintendents expressed interest in the relation between school success and success in college. This problem is of course not new, but it has usually been studied from the standpoint of college admissions rather than school guidance, with the result that the data base usually employed is oriented around college populations rather than secondary school populations. A related problem mentioned by school administrators is the relation between secondary school course selection and achievement, on the one hand, and occupational choice and selection, on the other. This is one of the central problems being studied by Project TALENT, but new dimensions of the problem might be disclosed by suitable analyses of data assembled in a regional data bank.

It will be noted, incidentally, that both of the above problems imply that the data bank must include longitudinal follow-up data. It will take special efforts to assemble such data, with all the problems attendant upon follow-up studies.

4. Experimental treatment research. An experimental study is one which through an appropriately contrived design seeks to establish a functional relationship between one or more independent "treatment" variables and one or more dependent "criterion" variables. Usually an experimental study in educational research involves some kind of deliberate "intervention" in the educational process, such as the introduction of a new curriculum, a new teaching method, a new regulation, a new environmental condition, or the like. Since an intervention is essentially an innovation or at least a procedure that does not occur in the normal course of events, experimental studies cannot be done solely within the data of an EDB, since such data are already of a historical character. It would be generally unwise to attempt to conduct a "post-hoc" experiment solely on the basis of data in an EDB, for it is unlikely that it would be possible to maintain adequate controls or to set up suitable experimental designs. "Nature"--i.e., the ordinary course of events--does not very often set up appropriate designs.

There are, to be sure, situations that simulate experimental designs. Campbell and Stanley (1963) call these "quasi-experimental" designs. For example, a school that had collected data in the first grade over a five-year period under a certain standard curriculum and then introduced a new curriculum might legitimately be considered a situation in which to compare the effects of the two curricula by purely statistical means, after the fact. Indeed, because of the difficulty of introducing interventions with adequate controls in "real life," the statistically performed post-hoc "experiment" may not be very much less valid than the typical "experiment." Data banks that contain adequate information as to the circumstances surrounding various (historical) interventions and adequate data on relevant control variables could rather successfully be used to make post-hoc analyses after the model of a quasi-experimental design.

As far as true experimental studies are concerned, the main use of the data bank would be to define populations from which to draw samples (usually on a random or stratificational basis) of students, teachers, school systems, etc. that could then be subjected (or not subjected, as the case may be) to particular experimental interventions or treatments. The data resulting from such experiments might find their way into the data bank, of course, but essentially such true experiments would be conducted and analyzed somewhat independently of the data bank itself.

Almost any type of experimental intervention in education might lend itself to study either in a pure experimental or in a quasi-experimental design. For example, one might study the effects of certain pre-school experiences in preparing children for school, the effects of the introduction of new methods of handling disciplinary problems, etc.

One special kind of "experiment" that would fall peculiarly within the province of educational data banks and the associated computer facilities is the simulation study, in which the effect of a certain intervention or action is simulated rather than actually observed. For example, one might simulate the effect of different school bus transportation arrangements by making reasonable assumptions about the conditions obtaining under each such arrangement; probably the dependent variables of interest in such a case would be cost and convenience, while the independent variables would be the geographical locations of the students and the scheduling of the buses.

The analysis of class assignments possible under different master schedules is another example of such simulation.

By making certain assumptions concerning time necessary for learning, amount of interference among subjects, and other relevant conditions, it might also be possible to simulate the learning process itself to study the effect of different schedules of learning. The data bank would furnish sets of initial conditions for such a study.

As a general conclusion on the role of the educational data bank in educational research, we can state confidently that there are many kinds of problems to which data bank use would lend itself. While use of data banks would present many problems and would rarely make it possible to conduct anything like a definitive study or a crucial experiment, this condition is not unique to the data bank context; the fact is that definitive studies and crucial experiments are exceedingly difficult to perform under *any* circumstances, data bank or no. On the whole, however, the availability of a data bank would be facilitative rather than inhibitory.

COOPERATION

We shall attempt to discuss first the kind of cooperation necessary to establish the regional EDB on an operating basis, and, secondly, the kind of cooperation which will be made possible by the existence of an operational EDB.

We offer as a pertinent example of the first kind of cooperation the very conferences on which we report. However, we must repeat the qualification mentioned in the introductory note to this chapter--namely, that the tripartite division of the conferences into *separate* gatherings of representatives from the three strata of the educational enterprise may not have been an ideal arrangement. In effect, this arrangement allowed only the principal investigators to appreciate the fact that each of the three groups, despite its characteristic approach to the problems involved, was largely enthusiastic about potential advantages--to itself and to the other groups--of educational data banks. But the misgivings each group expressed about the difficulty involved in establishing a regional data bank were usually directed against one of the *other* groups. If we had enabled the three groups to confront each other directly, perhaps these mutual misgivings as to the others' attitudes would have been forestalled by a more vivid sense of a common interest and goal--the possible improvement of education through the use of regional data banks.

The need for direct confrontation of, and communication among, the three groups is perhaps most evident to the reader in relation to the participants' discrepant attitudes towards the matter of local schools' cooperation in providing data. Researchers who are very concerned lest data-collection become an inconvenience to the schools emphasize the importance of minimizing additional clerical burdens and of providing the schools with immediate compensation, in the form of accounting-services, for whatever extra clerical work must be done. These laudable postulates, in turn, encourage a notion (which is also fostered by the somewhat unnecessary tinction between "research data" and "accounting data") that the EDB can at best devote but a small fraction of its time and facilities to research activities. And this prospect produces, in the end, an anxiety that researchers may become "the 'poor relations' of service-oriented data banks."

The state administrators also expressed concern over how to justify asking the schools for information. Reluctant even to exercise whatever statutory authority they may have--or may obtain--for securing uniformly reported data, the administrators felt that in order to win the voluntary participation of local school systems the EDB would have to assure them that it was interested in collecting information that had "real promise of producing results." To the extent that the term "results" was here a euphemism for "accounting services," this attitude towards local schools' participation in the EDB had something in common with that of the researchers. It differed in that it was not pushed to its logical conclusion--that is, to the notion of the "service-oriented data bank."

When we come to the attitudes of the local school superintendents themselves, we find, however, that they expressed no misgivings at all about the clerical burdens of data-collection nor any concern as to whether accounting-services will sufficiently compensate the schools for their participation in the data bank enterprise. In one respect, this did not surprise us, since the 34 school systems which subscribe to NEEDS' ongoing accounting services, and from which NEEDS is thus "banking" data, seem to agree that this operation saves them considerable amounts of money and man-hours, clerical and otherwise. But what was surprising to us--and what we now wish we had given the researchers and state administrators an opportunity to be surprised by too--was to hear the superintendents of 37 school systems, which are not associated with NEEDS or any other data-processing organization, unanimously express much greater concern for questions of research than for questions of accounting. In short, the school officials were in accord with the majority of the university researchers and state administrators as to where the greatest potential contribution of the regional EDB lies But unlike the others, they were not driven to discipline their hopes for the EDB, or intentionally to limit their concept of what it could accomplish, out of skepticism about the cooperation of local school systems. For they could bespeak the cooperation of the schools which they themselves represented.

Even were we to grant the validity of a dichotomy between "research data" and "accounting data," this widespread skepticism would seem to be unfounded in view of the above-mentioned facts that (1) schools already gathering "accounting data" for processing by an organization like NEEDS find that their efforts are well rewarded, and (2) schools which participated in this conference were more "research-minded" than schools are usually given credit for being. We concede that the second point is not generalizeable to all school systems, since of itself participation of the school superintendents in the conference reflected a possible atypical capacity for self-criticism and innovation. Be that as it may, we resist applying a similar line of reasoning in order to reach the conclusion that only unusually progressive schools will voluntarily subscribe to a "service-oriented data bank." Perhaps this is now the case, but as the school population continues to grow and to concentrate itself in and around cities, and as the attendant accounting problems continue to exert greater pressure on school personnel in those areas, the advantages of electronic data-processing will eventually, in a very direct sense of the term, "sell themselves" to all schools regardless of their administrative outlooks. And once schools begin to apprehend the short-term expedience of cooperation in providing "accounting data," they will be all the more ready to admit the probable long-term expedience of cooperation in providing "research data."

We do not think that researchers will have to wait long for a full measure of the second kind of cooperation mentioned at the beginning of this section, namely, cooperation of school people in supporting the continued operation of an EDB. In the first place, "accounting data" are of great and immediate utility for research purposes. (On this point, as has already been observed above, many researchers already agree.) In the second place, local school superintendents *may*--given the chance--be more "research-minded" than is thought. We do not go so far as to suggest that if, in organizing conferences for this study, we had not segregated the three types of educators from each other, the professors and state administrators would have indulged in the statistically rash assumption that the attitudes towards research expressed by the 37 school superintendents typify the attitudes of all the superintendents in the nation. But we *do* think that the professors and administrators would not so readily have made the opposite assumption, and would not then have felt so constrained to offer a strictly *quid pro quo* solution to the problem of cooperation. Of course it remains legitimate to think that from the schools' point of view, electronic accounting service will be the great "selling-point" of the regional EDB. But if there is any evidence that schools might also consider research to be a "selling-point," why prescribe an unnecessarily narrow "service-orientation" for the EDB as the only practical means for persuading the schools to provide "research data"? Why--to force the metaphor further--sell accounting services to schools in order to build up enough credit to buy their cooperation in research, if they too are in the market for research to begin with?

This line of questioning leads to the consideration that if regional EDBs can develop, as is generally thought possible, from electronic accounting services, perhaps they can also develop from cooperative research programs jointly undertaken by education school professors and groups of interested local school systems, with the participation, in the role of observer, sponsor, or coordinator, of members of the states' education departments. In suggesting this latter possibility, we begin to shift the focus of our discussion from the kind of cooperation necessary to establish a regional EDB on an operating basis to the kind which we had thought would *only* become possible when an EDB was already operational. Perhaps, then, the distinction between two kinds of cooperation will prove to be an unnecessary one, if, in planning the development of a regional data bank and in trying to foresee its ultimate usefulness, we can closely adapt the means at our disposal to the ultimate ends which we want.

These ends should include active rather than passive cooperation on the part of the schools. Indeed, since schools are vital, responsive social organizations, it is almost unthinkable to expect from them simultaneously both their active cooperation in providing data and their passive acquiescence to the particular "experimental design" for which the data are being gathered. But even if school personnel could manage to reconcile such psychologically inconsistent roles in a data bank enterprise (or any other kind of largescale research program), the cause of improving education through research would not be served nearly so well as it could be if they were not merely permitted but strongly encouraged to contribute their ability (1) to define *in their own empirical terms* the instructional, vocational, and administrative problems of education, (2) to suggest, on the basis of daily experience and informed guesses, how pressing each problem is, how much, and what sort of improvement can be expected, and, accordingly, what priority each problem may deserve in a research program, and (3) to advise researchers on practical means for carrying out their investigations. These potential contributions on the part of school personnel to educational research are matched in importance only by their present responsibility for implementing the very improvements which evolve from research. Rather than being the silent partners of professors and state officials, school personnel deserve and will richly requite full and equal voice in EDB research activity.

The ability of school personnel to cooperate in, and to contribute to, educational research in the active ways outlined above is now for the most part being wasted on account of inadequate, or non-existent, communication with researchers. Such communication and cooperation would be immensely desirable no matter how they were achieved. If, therefore, data banks could help open these lines of communication among educators, and foster unprecedented kinds of cooperative efforts, these are the goals that should be posited as the primary rationale, second to no other, of the regional EDB. And since these are our most important goals, we should, as stated above, try to realize them in our initial efforts to establish an operational EDB.

Chapter 5

An Illustrative Application of Data Bank Procedures

It would now seem appropriate to attempt to reassess and to integrate the concepts of data, access, and research in light of the primary goals of cooperation and communication which have just been proposed for the regional EDB. In order to do this, and, at the same time, to substantiate the suggestion that a regional EDB can evolve from a cooperative research enterprise, pertinent aspects of a project now in an advanced stage of planning at NEEDS will be described and discussed in this chapter.[1]

This project will aim to establish a prototype for a computer-based information system for vocational decisions which will automatically analyze, classify, store, process, and retrieve information relevant to the career decision-making of elementary and secondary school students. The computer-based system will be integrated with an educational program designed to assist these students in the decision-making process. The integrated educational program may be thought of as having two components: (1) a curriculum for vocational decision making which, in appropriately different forms, will be offered at various grade levels, and a major instructional resource of which at all levels will be the computer-based information system; (2) counseling assistance in regularly scheduled conferences, which will both help the student relate general aspects of the curriculum to his own decision making process and vocational planning, and also furnish extensive interview material necessary for continuous assessment of the student's decision-making capabilities in relation to his exposure to the overall vocational decision program.

As a cooperative venture, the heart of this project will be a network of relationships among a public school system in the Boston area, certain members of the faculties of five universities or colleges in the region, and members of the Massachusetts State Board for Vocational Education. Numerous other relationships will be entered into--corporations, government agencies, labor unions, educational institutions--to acquire and develop for the data base of the system the most exhaustive information possible about occupational patterns and manpower needs, present and future, in the New England region.

The above description does not exhaust all ramifications of the network of relationships which have been envisioned for the project, but is intended to suggest that the greatest potential resource of a regional EDB is neither data nor machines but people with common interests and complementary skills, and that the most important thing to be processed by an EDB is, again, not data but people's commitment to the cause of improving education.

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[1] The conceptual framework, general goals, and collaborative nature of this project have been summarily described by Tiedeman (1965, 24-29).

As the above description indicates, the people may belong not merely to the three groups of educators which constitute the educational profession proper, but also to a wide range of other professions and institutions. Each of these groups--and not least the educators'--has restrictive rules and conventions that limit its members' ability to commit themselves to independent efforts to improve education. Without in any way seeking to erode the distinct identity and structure of each group, the regional EDB should strive in a sense to incorporate them all, permanently or temporarily, in order that their restrictive rules and conventions may be circumvented for the sake of specified efforts by their members towards the overall goal of improved education. The EDB in this way can minister to the commitment of members of many diverse groups to specific educational efforts, by allowing or encouraging this commitment to manifest itself in mutual cooperation and communication. The tangible results of the latter may include new or improved curricula, proven hypotheses, stores of computerized information, new computer techniques and, most important, the possibility of future cooperative efforts implicit in each of these last. Thus, the regional EDB's potential for processing people's commitment to the cause of improving education is not limited by the number of local school systems which subscribe to its accounting services, nor the number of professors on its board of directors or in the school of education with which it happens to be most immediately affiliated. Nor are the tangible results of the regional EDB's processing of commitment potentially limited by the relatively episodic nature of the network of cooperation and communication which it may create for a specific effort. Indeed, it seems reasonable to expect, though it is by no means necessary to insist, that relationships among schools, universities and states' departments of education will outlive the *ad hoc* reason for which they were entered into, and will thus remain available not only for continued free interchange of ideas among school, university and government personnel but also for future joint undertakings.

New kinds of information, or already existing kinds presented in novel formats or to novel ends, will be input to, and processed by the NEEDS Information System. For example, computer controlled display devices will present to the participating students, in terms of requisite skills and in English, descriptions of occupations prevalent in the New England region. Integrally related with occupational description will be such other information as: evaluative remarks regarding the student's skill potential; statistical projections (which the student will be taught to interpret) of future needs for skills which are required for the occupations about which he is inquiring but which also may either become requisite for new occupations or be partially or completely supplanted by a combination of different skills and new technology; and experience tables derived from follow-back studies of recent graduates with skills and interests similar to his own. It is significant that in these follow-back studies, "accounting data" which were gathered prior to the former students' graduation and which record their performance and aptitude in high school, will be just as useful for correlational purposes as "research data" which will have been gathered by means of questionnaires in order to find out about these former students' post-graduation career decisions and experiences.

Perhaps the most significant new kind of information to be used will be a summary record of the student's inquiries and the information which the computer system will have presented to him in response to these inquiries. Thus the system will not only be responding immediately and with appropriate selectivity to frequent requests from each student, but will also, by means of a special executive program, be monitoring each student's interaction with itself. This continuous feeding-back to the student, to his guidance counselor, and to the research investigator, of a cumulative record of the vocational information requested by each student is expected to be an invaluable help in making explicit the student's emergent vocational self-concept, and his occupational constructs and interests. Moreover, the fact that the project will put this sort of feedback to many uses suggests that data bank users may become, in a more direct way than previously imagined, providers of data of extraordinary interest.

In general, then, the project will emphasize (1) information as an element in the process for which computer technology offers a mechanism for systematic analysis, individualized presentation, and evaluation; and (2) information as an element generated by the individual from analysis of his own prior decisions (as well as those of former students) and from his use of "outside" information on a new decision *in relation to his analyses*. Both these categories of information--that provided to the student and that created by him--are regarded as the necessary content of decision-making. And since the quality of decision-making is ordinarily directly related to the quality and comprehensiveness of the information required by the decision-maker, and since information in both the above categories will be constantly changing, this information will undergo constant verification and updating. In this way it is hoped the project may bring about what will approach ideal circumstances for studying the interaction between information and decision-making.

The existence of a regional EDB as a structure and mechanism for processing commitment makes possible a given project's access to the diverse human resources it needs to implement its specific educational goals. Essential relationships thereby developed may, in general, be thought of not as prerequisite to the establishment of a regional data bank but rather as part of its self-developmental response to the projects which it undertakes.

The same general principle is applicable to the problem of users' access to the information to be stored in the computer system of the regional EDB; that is, existing technological means should be construed as prefiguring rather than as limiting future technological possibilities for retrieving information in desired formats. Technological possibilities should first be defined in terms of expected users' needs, then modified in terms of what is financially practicable. But financial practicability will ultimately depend--and this is as it should be--on the importance of the educational goal: federal and state government, and the great foundations--the sources from which funds are to be sought--can be expected to regocnize, and to support, those efforts which give promise of solutions to pressing, widespread educational problems. Moreover, the earlier developmental stages of the regional EDB will be the ones in which costs will be greatest in proportion to immediately achieved educational benefits, investments in many diverse aspects of initial projects (and not merely in such peripheral computer hardware as is not quickly subject to obsolescence) will yield substantial dividends for subsequent projects. In view of these financial considerations, the assumption underlying all educational research--that the value of its results depends upon their entry into practice--is particularly apposite to initial EDB developmental projects, and should, indeed, be applied as the major criterion of the priority with which they are undertaken.

The NEEDS vocational decision-making project will purpose to meet this criterion in two extremely significant ways pertinent to the technology of access. First, the project will give promise of solutions to the pressing need for effective access to enormous amounts of occupational information which (a) is not merely changing at a pace directly contingent upon, and measurable by, the unparalleled pace of basic socio-economic change in the nation, but which (b) must also be simultaneously and selectively related to the large and even more rapidly changing body of information about individual students. Second, some of the technical means to be developed to meet this particularly pressing problem of access are expected to be generally applicable to the universal data-access problem which all regional data banks will inevitably have to confront in subsequent developmental programs. It is becoming increasingly evident that substantive differences in the educational areas to which computer technology is applicable do not logically require that there by corresponding differences in hardware. A particular machine configuration suitable for, say, computer assisted instruction may be the very configuration desirable for such other activities as selective school law retrieval, display of student information to guidance counselors, or an information system for student use such as the system herein described.[1] The notion, then, of an electronic network whereby terminals in schools, universities, and states' departments of education throughout the region may be linked to a computer-complex and data base of their EDB recommends itself as the ideal means for providing access.

Thus, recent technical gains made in time-sharing, tele-processing, computer display media and the like should be explored in initial EDB developmental projects with an awareness of the radically expanded kind of access that will become desirable, and necessary, if electronic networks are to parallel, to complement, and to be allowed to *interact* with, prospective networks of cooperative institutional and interpersonal relationships. The NEEDS vocational decision-making project will make such an exploratory effort in relation to the project's specific goal of studying the interaction between vocational decision-making and vocational information. Hardware desiderata for the project will include consoles at the participating schools which will provide students and their counselors with direct access to the data-base, and "media rooms" at the schools where students may, as it were, *browse* at their convenience through occupational information presented to them on slides, film, television and tape by computer-controlled audio-visual equipment.

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[1] Not only is it reasonable to expect the same hardware configuration to be applicable to several different activities, but it is further expected that such activities may utilize the hardware at the same time, that is, as part of a maximally uncommitted time-sharing system.

A fundamental characteristic of the NEEDS vocational decision-making project will be that its research activity will be conceptually and functionally inseparable from services it renders to its participating schools. As presently formulated, the design of the project is not unlike that of the kind of computer simulation-study that aims to define rather than to predict, since the project's research objective is to understand the process "decision-making" and its research procedure is, in effect, to construct a model of that process. However, the model will consist of a complex curriculum to be incorporated into the living structure of several schools. Continuous, microscopic observation of the model/curriculum will yield more precise understanding of the process "decision-making," which understanding will, in turn, suggest adjustments and revisions in the model/curriculum.

Not every field of educational research offers so dramatic and immediate an opportunity as does vocational decision-making for simultaneous theoretical advance and practical innovation. (Perhaps this is because no other educational field has had to wait so long for recognition as being not only "teachable" but worthy of being taught.) Nevertheless, the current efforts of professors of education in all fields to expand their research base--that is, to study more variables derived from larger samples over longer periods of time (Carroll, 1965)--will naturally tend to draw theory and practice closer together, if only in the superficial sense that the only way for professors to achieve this expanded research base is to spend more time either actually in, or in touch with, more schools. Do some research investigators conceive of the regional EDB as an instrument for obviating such personal exposure on their part to school environments? If so, and if this in fact proves to be the purpose of the EDB, then it will have destroyed its own greatest promise--the chance to bring about an overlapping of roles and mutual redefinition of functions among educators. If, however, research investigators and state administrators freely exchange points of view and insights with school personnel, and, most of all, try to learn how schools' daily problems may define research priorities, then the EDB could serve to coordinate and to extend such relationships with the overall aim of transforming every classroom and office in local school systems into a potential laboratory for educational research. Then perhaps a great many research projects could be undertaken with the purpose of understanding educational processes by means of constructing and studying models of them, with the crucial components of the latter being both people and machines. Such would be the union of the theory and practice of education.

The least restrictive view of the regional EDB thus far to have gained any wide adherence among professors of education is that of the EDB as creating an opportunity for *research in a service-context*. The catch phrase could have one of two meanings. It could mean a relationship in which schools are renumerated or rewarded, in terms of accounting services, for their more or less passive cooperation in providing "research data" to a professional elite; or, it could mean an equal partnership among these two groups and that of the state administrators, *with each group conceiving research itself to be a direct service to the school.* If the regional EDB could help bring about "research in a service-context" in the second sense of the phrase, theory could be expected to enter into practice faster than would otherwise be possible, and the pace of educational improvement would be responsively quickened.

The foregoing sketch will already have indicated a number of specific ways in which research in a service context--that is, research conceived of and undertaken as a direct service to schools--can foster an overlapping of roles and redefinition of functions among educators. The possibility of simultaneous theoretical advance and practical innovation may be considered a kind of empirical corollary of such overlapping and redefinition. For when the theoretician and he who is responsible for eventually implementing theory in practice begin in joint efforts to exchange--or, rather, to share--each other's roles and functions, then the results of their joint efforts will inevitably reflect both men's initial speciaties as mutually modified and enriched by their subsequent interaction. Indeed, the joint creative achievement--i.e., the educational improvement--will necessarily surpass whatever sum of results would have been possible had each man pursued his specialty in isolation from the other.

It has also been shown that in the NEEDS vocational-guidance project, communication and cooperation which may lead to such overlapping of roles and redefinition of functions among educators began with the very inception of the project, have developed and expanded in its planning stages, and are expected to be fulfilled in the execution and continuous refinement of the plans and in the assessment of their outcome. The very last phase of the program will also require communication and cooperation--and on an even more extensive scale.

This last phase will hopefully be the exportation of the NEEDS decision-making program to interested schools in the New England region. For the data base of the information system will have been gathered with this comprehensive end in view, a mechanism for continued communication will have been established to guarantee updating--especially of forecasting information; means of access to the data base and computer system from remote locations will have been developed; and the curriculum of which the information system is to serve as an essential part will have been tested and revised.

After the program has been exported to schools throughout the New England region, the immediate prospects for the extended network of relationships that will thus have been elaborated would include (1) expansion of the vocational decision-making program to meet pressing problems in the area of general guidance in the comprehensive high schools of already participating and other school systems, and (2) formulation of new cooperative projects in research areas other than that of student development.

Would it be only then--that is, at the point of diversification of its research activities--that this extended and continually growing network of relationships could deserve to be called a regional EDB? We think not.

Indeed, we venture to think that an EDB for New England exists *already* in the network of relationships that have been entered into during the planning stages of the NEEDS Information System. And we trust that regardless of the outcome of that project, this regional EDB will continue to exist and to grow according to the practical paradigm implicit in our definition of a regional EDB as a network, electronic and otherwise, of relationships which processes and administers the commitment of individuals and institutions to the cause of improved education by encouraging their commitment to manifest itself in communication and cooperation.

Chapter 6

Planning and Establishment of a Regional Data Bank at NEEDS

The activities undertaken in this study included, besides the holding of a series of conferences concerned with problems of setting up and maintaining educational data banks, the actual planning and establishment, at least in its early phases, of a regional data bank at the New England Education Data Systems (NEEDS) organization.

In order to describe what has been done to establish this data bank, it is necessary to present an account of the history and organization of NEEDS.

Overview of the NEEDS Organization

NEEDS is a political experiment created to provide research and service to the education community by serving as the link joining education agencies at the state, university, and local levels. As viewed by the local school system, NEEDS exists to aid the administrator--by removing the inefficiencies attached to clerical tasks and by providing a mechanism to assist decision-making--to conduct his school with a maximum concern for the needs and the development of the individual student. At the base of every school system, of course, is the hope that the individual student will be adequately prepared for the society in which he will work and live. But the realities of running a school--such things as production of schedules, report cards, class lists, attendance records--because of their immediacy, require attention and time.

NEEDS seeks to provide ways to reduce the time and attention taken by these clerical tasks, thereby releasing the administrator and his staff for more important, creative work such as assessment and reorganization of the curriculum. But this is only one function of NEEDS. There are others--improved communication among universities, schools, and state departments of education, educational research, and organization and dissemination of school data.

The overriding aim of the program is to improve the operating machinery in education so as to individualize the instruction of each student. The pressure to develop ways and means of keeping each student "on target" is increasing as greater and greater numbers come to the doors of the schools. To achieve this aim, there are many challenges which NEEDS must meet. Some of the most pressing ones are:

1. to eliminate the bottleneck around information in school systems due to the traditional procedures of record keeping.

2. to provide quickly accurate information for the use of state and federal agencies in their planning and financing of education.

3. to establish effective machinery to relate the research of universities to the day-to-day life of the school systems.

4. to bring technological improvements within the economic range of the public schools.

5. to develop a body of personnel with technological skills in both education and data processing.

6. to close the gap between the sophisticated level of data processing in business and the low level of school data processing.

7. to aid in the revision of state legislation so that the machinery of government will not impede logical and effective change when and where it is indicated.

8. to develop in public education the quality control techniques to promote more sophistication in school administration.

The executive branch of NEEDS consists of a Board of Directors, assisted by three coordinating committees. The board determines NEEDS policy. The three coordinating committees which aid the Board of Directors in planning and coordinating NEEDS activities represent the three areas of education in New England which NEEDS is designed to serve--local school systems, state departments of education, and universities.

A Project Administrator and his staff give overall direction to the operational structure of NEEDS, which is divided into four discrete but inter-related sections and which carries on the activities in which NEEDS engages.

A coordinator, the key contact between NEEDS and the member school system, is appointed by his individual school system to deal with all operational matters. His responsibilities to NEEDS and to his system are many. Within his system his job is one of data management, which includes acquainting the staff with necessary procedures for using data processing methods, planning a processing schedule to meet his system's requirements, and seeing that the schedule is kept by all members of the school staff.

At times the coordinator is present when his information is processed. Although NEEDS can make necessary changes in the programs being used, only the coordinator can make changes in the data.

The following list contains the names and titles of those individuals currently serving as members of the NEEDS Board of Directors:

Richard S. Goodman, Chairman	Executive Secretary NESDEC
Charles E. Brown	Superintendent of Schools Newton, Massachusetts
John B. Carroll	Professor of Educational Psychology Harvard University
John B. Chaffee	Superintendent of Schools Wellesley, Massachusetts
Vincent F. Conroy	Executive Director of the Center for Field Studies Harvard University
William H. Curtis	Superintendent of Schools Manchester, Connecticut
Roland Kimball	Professor of Education University of New Hampshire
William P. Robinson, Jr.	Commissioner of Education Providence, Rhode Island
William J. Sanders	Commissioner of Education Hartford, Connecticut
Elmer Smith	Chairman, Department of Education Brown University
David V. Tiedeman	Professor of Education Harvard University
Norman Zachary	Director, Computing Center Harvard University
Murray Pfeferman (Observer)	United States Office of Education

A coordinating committee for state departments of education has been constituted at NEEDS to provide a means for coordinated research effort among the chief state school administrators in New England. Similar committees for universities and for school systems are in the process of being formed. The composition of the state department coordinating committee is as follows:

Connecticut

William J. Sanders, Commissioner
Represented by
    Maurice Ross, Chief
    Bureau of Research, Statistics and Finance

Maine

William T. Logan, Jr., Commissioner
Represented by
Asa Gordon, Executive Director
Division of School Administration Services

Massachusetts

Owen B. Kiernan, Commissioner
Represented by
Raymond Dower, Director
Division of Research and Statistics

New Hampshire

Paul E. Farnum, Commissioner
Represented by
Paul Fillion, Chief
Division of Administration

Rhode Island

William P. Robinson, Jr., Commissioner
Represented by
Edward F. Wilcox
Associate Commissioner

Vermont

Richard A. Gibboney, Commissioner
Represented by
Frank Hensel, Chief
Education Research and Statistics

Membership in NEEDS is open to schools that are members of the New England School Development Council (NESDEC), and to colleges, universities, and state departments of education in New England. The current membership costs per school system, which are subject to review and adjustment by the Board of Directors, consist of a basic charge of $300 plus a per capita charge of $2.50 for secondary school pupils and $1.50 for elementary school pupils included in the project. The members of NEEDS are as follows:

DATE JOINING	SYSTEM	SUPERINTENDENT	COORDINATOR
	Newton, Mass.	Charles E. Brown	Joel Berg
	Weston, Mass.	Otty Norwood	Donald Hale
	Harvard University	Theodore R. Sizer, Dean	Paul Perry
July 1963	Arlington, Mass.	Burt Roens	William Gibbs
	Branford, Conn.	William H. James	Thomas Bouley
	Manchester, Mass.	Foster H. Ball	Charles Ashley
	Middletown, R. I.	Joseph H. Gaudet	Jerome Callaghan
	Stoughton, Mass.	Joseph H. Gibbons	Robert McLaughlin
	Westford, Mass.	Lloyd G. Blanchard	Harold Ready
	Winchester, Mass.	Harry V. Gilson	Norton Demsey
Jan. 1964	Concord-Carlisle, Mass.	Robert S. Ireland	Kenneth L. Creighton
	Danvers, Mass.	Clifford J. Good	Eugene Crowell
	Manchester, Conn.	John T. MacDonald	Blaine Miller
	Sharon, Mass.	Arthur W. Danielson	James Dowd
	Wellesley, Mass.	John B. Chaffee	Bedros Jid Kamitian
	Wilton, Conn.	Anthony Brackett	Richard Sell
April 1964	Belmont, Mass.	John W. McGrath	F. Gertrude King
	Westwood, Mass.	Erwin A. Gallagher	Isaiah Chase
July 1964	Cambridge, Mass.	John M. Tobin	Edmond Murphy
	Melrose, Mass.	Harold T. Rand	Paul Banks
	Swampscott, Mass.	Charles J. Whitcomb	Jennie McVey
Oct. 1964	Milton, Mass.	E. Davis Woodbury	William Creighton
	Natick, Mass.	Alfred A. Maffeo	Arthur Sticklor

DATE JOINING	SYSTEM	SUPERINTENDENT	COORDINATOR
Jan. 1965	Acton-Boxborough, Mass.	William L. O'Connell	Raymond J. Grey
	Brockton, Mass.	Edwin A. Nelson	Richard McRae
	Cohasset, Mass.	William Ripley, Jr.	Frank Wunschell
	Enfield, Conn.	Charles Szuberia	Joseph Cabrera
	Hull, Mass.	Peter V. Garofoli	Nicholas Meleones
	Longmeadow, Mass.	Robert D. Russell	Donald Fuller
	Marblehead, Mass.	Aura W. Coleman	Ralph Hull, Jr.
	Wayland, Mass.	R. Bruce McGill	Frank Gifune
	Whitman-Hanson, Mass.	Edwin W. Rowell	Charles Venslauskas
April 1965	Barrington, R. I.	Ian D. Malcom	Albert D. Genetti
	Springfield, Vt.	Winston B. Keck	Elizabeth Bean
	Watertown, Mass.	Francis A. Kelly	Joseph Bannon
July 1965	Salem, N. H.	Wendell V. Davis	Don Randall
	Suffield, Conn.	Hugh Watson	Carl Lundquist
	Bennington, Vt.	George Sleeman, Act. Supt.	Charles Decker

Operating Structure of NEEDS

The operating structure of NEEDS is divided into four sections or areas entitled: (I) Data Processing Services, (II) Operations Research and Development, (III) In-Service Training, and (IV) Basic Research and Formal Instruction. It is possible, through careful coordination of the efforts of these divisions, not only to provide data processing services to the schools but, in addition, to use such service as the context for the reexamination of educational procedures and practices.

The data processing service section (Area I) supplies the ongoing services to the school systems and coordinates all related dissemination functions. In this section are the technicians who operate the hardware and actually supply the member schools with the services that are currently operational. It is staffed by a director of data processing services, supervisors of the various machine installations, machine operators and clerical assistants.

The operations research and development section (Area II) seeks the Board of Directors' guidance for project priorities and designs the techniques utilized by the service section. All experimental work on operations is done here. Its responsibility is to bring experimental projects up to the point of being operational, supply the necessary documentation and publications, and then move to another task. Refinements and improvements are its constant job, which requires close cooperation with the other groups. This section is staffed by computer programming specialists and systems analysts. The staffing needs change as the tasks change.

The in-service training section (Area III) is responsible for training the member school systems' coordinators of data processing to utilize the facilities of NEEDS to increase the efficiency of their systems' operation. It conducts technical sessions and summer institutes to instruct the coordinators in the methods and techniques needed at all levels touched by this project. The coordinators in turn instruct the local school personnel. It is through this program that the full advantage of NEEDS is realized.

The section entitled Basic Research and Formal Instruction (Area IV) is staffed by Harvard University. Its goal is to develop a systematic program for educational research on problems confronting schools in the New England region.

One of the first steps taken in this direction is the planning and development of the regional data center of NEEDS which will provide data in the quantity and the form to facilitate this research.

In addition, formal courses are offered students at universities in the region to assure the requisite sophistication in computer skills and research techniques.

NEEDS Systems

Services rendered by NEEDS to its members fall, for the most part, under five operating systems entitled: File Creation and Maintenance, Scheduling Support, Mark Reporting, Automated Attendance, and Test Scoring and Analysis. The input and output of these systems form the universe of data from which the present contents of the NEEDS data base have been selected. Naturally the flow into the data base will intensify as the number of services increases, although only in the first stages of development will we limit the contents to data that are byproducts of such service. As the data bank begins to function as a medium to foster communication among various agencies of the education enterprise, we propose to solicit other data--of the form and type recommended by conference participants--directly from these agencies so as to establish a broad base of educational data. Since the present status of the data base is determined by existing services of NEEDS, a brief description of each of the operating systems is herein provided.

File Creation and Maintenance

One service that NEEDS offers to schools is the creation and maintenance of a file that contains basic information about the pupils. The teacher writes this basic information on a standardized form only once. These forms are brought to NEEDS where the information is transferred to IBM cards, one for each pupil. These cards constitute the "Pupil Master File" (PMF). Data on the cards are "machine retrievable" in that any part or all of the information can be "retrieved" from the cards and printed on paper or other cards. Thus, NEEDS is able to produce school directories, address labels, etc., and print any of the information that is needed on other documents such as report cards, attendance cards, and registers. Much duplication is thereby eliminated. The standardized "Pupil File Entry Form" also provides data for other files.

In addition to the Pupil Master File (PMF) which contains basic information, NEEDS maintains other files such as the Guardian and Parent Address File which includes name and address information and previous course credits.

The master file contains the following information for each student: name, school, previous credits, identification number, homeroom, year of graduation, counselor, street code, address, telephone number, date of birth, parents' initials or guardian's full name, sex. Most of this information is punched onto a pupil master card, often referred to as a "5" card since a "5" is punched in card column 80. If the pupil's parent or guardian has a surname that is different from his then a second card, called a "Guardian and Address Information" or "8" card, may be maintained.

In terms of data base activities each student may be uniquely identified by a combination of school code and ID number. Since updating of the PMF is built into the file creation and maintenance system, this function need not be performed by the data bank staff.

The following is a list of some of the computer programs used as a part of the file creation and maintenance system:

No.*	NAME	FUNCTION
F80	Assignment of ID numbers.	Initial assignment of ID numbers to pupils.
F87	Assignment of ID numbers for incoming students.	To assign ID numbers to large blocks of students entering an existing file.
F20	PMF Blocked Record Builder	Records PMF on magnetic tape.

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*The letter preceding the program number identifies it as a 1401 program (F) or a 7094 program (N).

No.*	NAME	FUNCTION
F21	PMF Blocked Record Update	Allows the addition, deletion and/or replacement of records on a magnetic tape generated by F20.
F23	PMF Display	Generates PMF listings breaking page control on different streets if desired. Will also punch the PMF from a tape built by F20.
F25	Print Gummed Labels from PMF tape.	Prints address labels from an F20 built tape.
F123	Age and Grade Calculations	It produces statistical tables showing the number of students in each grade by the age of the students.
F124	Homeroom Assignment	Assigns homerooms to students alphabetically by year of graduation.

Scheduling Support

The Scheduling Support system is designed to eliminate the clerical work usually required for scheduling secondary schools. Information is compiled and presented in ways that make it easier for the school principal to design a master schedule which, when created, will be used as input to a computer program which assigns pupils to classes. Prior to the actual assignment of students to classes, a number of "simulation" runs are made in which only those students for whom it is not possible to produce a schedule are identified. When the number of such students is a minimum the actual schedules are produced.

The process begins when a school furnishes NEEDS with (1) a course catalog which includes the name of each course and an identifying number, (2) a teacher catalog which includes the name and identifying number of each teacher in the school, and (3) the specific course requests of each pupil. This information is keypunched and processed to produce three documents which are sent to the school. The first of these documents is called a Course Request Verification List. This document lists those courses each student has elected for the next year, and is sent as a check that he is carrying an appropriate credit load and to provide a record of elected courses for verification.

The Simple Tally, the second of the three documents sent to the school principal at this point, lists each course with the number of students electing it. With the information gained by having this list, the principal may cancel courses with no requests, or create extra sections for courses with more requests than anticipated.

A Cross Tally is also provided. This tabulates the number of students electing a particular course who have also elected any one of the other courses offered. It provides useful clues for avoiding some conflicts in the establishment of the master schedule. The school uses this information as aids in designing a master schedule.

The school then submits to NEEDS a master schedule which specifies the periods in which each section of each course will meet, the optimum number of pupils in each section, the maximum number of pupils that may be included in each section, the number of the teacher of each section, the number of the room in which each section will meet, and the identifying course number.

The following three types of directories are prepared by NEEDS to aid the school in evaluating the master schedule: (1) the room utilization directory lists in succession the sections meeting in each room, including a display of course names and numbers, teachers' names, the time periods and seating data; (2) the teacher utilization directory includes the same information with the sections taught by each teacher arranged successively; (3) the course directory lists courses in succession.

After studying these directories, the school may desire to make certain changes in the master schedule. If so, they are reported to NEEDS on standard updating forms so that these corrections may be made in the input data.

Once all corrections have been noted, there begins the process of simulating the assignment of individual pupils to classes. To evaluate the master schedule in terms of the students' course elections, a "conflict chart" is produced for each student whose requests create an irresolvable conflict. Other parts of the "simulation run" display the courses causing difficulty in assignment, the number of students assigned to each section, a list of courses showing those that are not perfectly balanced, and courses that are filled (those reaching their optimum size) and courses that are closed (those reaching their maximum size).

The purpose of simulating the assignment of pupils to classes on a computer is to aid the school administrator in improving the master schedule in such a way that the needs of individual students may be met to an increased degree. After analyzing the simulation output the administrator then makes changes in the master schedule and, if necessary, the student requests, and NEEDS repeats the simulation process.

Because computers are many times faster than human beings it is possible to schedule a school several times during the summer. After a number of simulations most of the problems are resolved and schedules may be printed from the output of the same computer program which simulates assignment of pupils to classes.

It is possible, by computer analysis of the output tape containing each student's schedule, to produce such other documents as homeroom lists, class lists, and study hall lists. In addition to these lists, NEEDS makes available trained people who aid coordinators and their administrators in interpreting scheduling output and who advise these school representatives of alternatives available to them in scheduling their schools.

The following is a partial list of some of the computer programs used as part of the scheduling support system:

No.	NAME	FUNCTION
F90	Course Request Verification	Displays the course numbers and course names and credits associated with elected courses.
F17	Course Request Maintenance and Display	Provides individual course request updating as well as general file updating of the pupil course request file. Also will produce various displays of course request file.

No.	NAME	FUNCTION
F75	Print Lists of Students requesting prespecified	To print lists of students requesting prespecified courses.
F57	1401 Combined Tally	Produces simple and cross tallies using 1401 with 1311 disk files.
N35	7090 Combined Tally	Same as F57 except that it uses 7094 and has a limit of 350 courses.
F61	1401 Simple Tally	Provides a simple tally of student course requests. Also will provide complex tally of logical sets.
N20	7090 Simple Tally	Same as F61 but uses 7094.
F110	Variable Formats Simple Tally	Provides the same function as F61, but it does not require that course request records be in standard NEEDS format.
N1 Version 2	Assignment of Pupils to Classes	Assign pupils to classes using a pre-built Master Schedule.
F104	1401 Pupil Availability	Generates a display of the number of pupils available after assignment to classes for each period of the week.
N27	Pupil Availability by period.	Same as F104 but uses the 7094.
N41	Pupil Avaiability by course.	Displays the number of pupils after assignment to classes who are available for specific courses to which they were unassigned. A separate display is made for each course listing the number of pupils available each period who have unsuccessfully requested it.
F54	Print Student Schedules from version 2 tape.	Prints student schedules, sorts each student's courses, merges in other input files such as locker number files for use with version 2 input.
F128	Print Student Schedules with linked sequence.	Prints students schedules from N1 version 2 output using 1311 disk drives. It is possible to define linked sequence after N1 has been run.

No.	NAME	FUNCTION
F49	Print Class Lists from Version 2 Tape	Prints class lists from a tape produced by program F54 and sorted with Sort 7.
N43	7090 Class List Generator	Sorts scheduling output records and generates a tape containing class lists.
F86	Teacher Schedule Display	Print teacher schedules from Master Schedule cards.
F84	Convert Version 1 Master Schedule to Version 2 format	Converts Version 1 Master Schedule to Version 2 Format.
F88	Print Student Schedule from F24 Built Report Card Tape.	Prints Student Schedule from F24 built card tape.
F115	A2 to A2.	Copies N1 input tape on to another reel.
F132	Translate Time Patterns	To punch N1 version 2 output files including exploded or unexploded study hall records. It is possible to translate NEEDS format time patterns into other time patterns by the use of a time dictionary.
F131	Print Study Lists from Cards.	To prepare study hall lists from study cards processed by F132.
F50	Explodes Study Hall cards	This program explodes study hall cards so that there is one card per pupil per day per period.

Mark Reporting: Recording, Display, Analysis

At present the Mark Reporting system provides the data base with the most comprehensive set of data resulting from NEEDS' data processing services. One reason for this is that the report card output tape for each school is constructed, in part, by merging a number of other files which otherwise would have to be stored separately or combined in a separate operation. Since the merging of these files is a necessary part of the report card production, the data enter the data base in a convenient, well managed form.

Using information available from the pupil master file card, mark sense cards are produced for each student. These "Mark Information" or "7" cards are grouped by class, each group of cards being preceded by a Teacher Header card, and sent to the school. Depending upon the grading system adopted by the school, the teacher will enter on his classes' "7" cards such things as grade, comment, and credits for each student. When these cards are returned to NEEDS they are mark-sensed, sorted by student, and merged onto tape along with such other sets of cards as the pupil master file, the "8" card file, and the attendance file (see below). Among the data contained on this tape--which will be used to print report cards for each student--are the following: student name; parent (or guardian) name and address; year of graduation; student number; previous credits; the course name, number, teacher, grade, and additional comment code; days absent, and times tardy and dismissed. Naturally at the end of the year the report card tape will contain grades for each marking period plus, in many cases, an examination and a final grade.

Uses to which such a tape might be put come easily to mind. Mark distributions, course selection patterns, student averages, attendance habits, and the like all provide useful information to the school staff or to the student. It is interesting to note, however, that the existence of such a tape makes possible at least one other analysis not otherwise convenient. Because it contains information relating to each other the student, teacher, course, section, room, and meeting time, this tape can be reordered to produce a general picture of the schedule under which the school actually operated during the year, which of course is rarely the same as the schedule under which the school opened in September. Since the NEEDS data base contains such information for approximately fifty schools, and since it will be accumulating this information over a period of years, it now becomes practicable to initiate an extensive analysis of the school scheduling process and of the relationship between the schedule on the one hand, and the curriculum and the instructional goals of the school, on the other.

This brief description of the Mark Reporting system has touched on the highlights only. Such things as weighted grade point average calculation, updating procedures, and graphic display of grade information have been omitted. Some notion of the scope of this operating system may be gotten, however, from the following list of some of the computer programs used in the Mark Reporting system:

No.	NAME	FUNCTION
F26	Explode Pupil Information Cards into 10/Pupil.	This program explodes mark sensing cards for report cards (10 per pupil unless otherwise specified).
F24	Report Card File Builder/Class Lists	Records, on magnetic tape, all information (Mark, attendance, address, previous credit) pertinent to pupils that are to be displayed on report cards. Performs mark translation. Produces class lists and 1401 mark distribution input.
Sort 7	IBM's 1401 stock tape sort.	Used to prepare input from F24 sorted form needed by program F32.
IBSYS	Sort	Same as above for 7090.
Sort 6		IBM 1401 program. Same function as above but uses disks.
F112	NEEDS Tailored 1401 Report Card Sort	This program takes the unsorted report card tape produced by NEEDS program F24 and sorts it into an order acceptable to program F32.
7090	Sort	A 7090 sort as back-up for F112.
F32	Report Card Print/Error Check/Summary	Prints report cards. Edits data for improper number of course, courses, bad attendance record, etc. Produces lists of Incompletes, Failures, and Withdrawns. Updates previous credits, etc.
F85	1401 Mark Distribution	Displays distribution of alpha marks for all classes within their courses, by teacher and by department. Gives percentage as well as actual distribution.
F136	GPA Tape Builder	Prepares an input tape for the Grade Point Average program (F134).
F134	Grade Point Average	Produces single- and multi-curricular grade point average calculations for any combination of three time periods: academic career to date; year to date; current marking periods.

No.	NAME	FUNCTION
N25	Curriculum Weighted Grade Point Average Calculation	Will calculate a cumulative or current simple or curriculum weighted (for up to 9 curricular) grade point average. Allows variable input. Used for Newton Junior College.
F70	Newton Junior College Summary Builder	Produces summary tape for use with N25 for Newton Junior College.
F114	Variable Input-Output Format Averaging	Reads the output tape generated for the purpose of report card printing and computes the student's average grade for a particular course.
F116	Report Card Tape Duplicate and Edit	Aids in the manipulation and Rearrangement of the data stored on the NEEDS report card tape.
F135	Punching Selected Card Files from F24 Built Report Card Tape	This program takes a NEEDS standard report card tape and punches from it the card files that were used to build it.
F72	Newton Junior College Report Card Printing	This program performs three functions: prints a report card containing pertinent student information; produces a label image containing grades, credits, and grade point average information; inserts the new credit information in the student address card.
F129	Middletown Report CArd Program	This program takes a sorted report card tape built by F24 and prints report cards on the Middletown report card form.
F88	Student Schedules from Report Card Tape	Merges and sorts report card tape with card file input to generate updated student schedules after first marking period.
F74	Report Card Variable Format Lister	Generates gummed labels containing information from the report card tape (F24) in any desired display configuration or format within reason.

Attendance Accounting

NEEDS' Pupil Attendance Accounting system will be described cursorily since of all the operating systems it is at this time the least likely to produce data of any significance to research envisioned as part of the proposed data bank activities. This impression may be the result of a lack of understanding of the value of such data since, certainly, they are not totally without use. As we begin to develop the data base, however, we shall adopt a somewhat conservative attitude and heed the recommendations offered by conference participatns that since data collection though it be broad can never be truly total, data ought not to be accumulated without at least some preliminary notions as to the research questions they are likely to be used to answer.

NEEDS performs two types of attendance accounting services for its members. The first and more usual of these services consists simply in maintaining a file, into which data are fed by means of mark sensed attendance cards, which contains for each student a count of the number of times he was reported absent, tardy, or dismissed. Each marking period this file is merged with other files to produce the report card tape previously described.

A second, more extensive service is available to those Massachusetts schools that are members of the NEEDS Project. This system entails the automatic preparation of a school's attendance register. The NEEDS attendance register was designed in cooperation with the Massachusetts State Department of Education, and is designated form ED. ADM. 2-964-AF 1. Three copies of the attendance registers are produced each month, two of which are given to the school and the third of which is retained at NEEDS.

The input to this system, as in the case of the aforementioned attendance file, is a mark sensed card containing daily attendance information for each student. The processed tape, from which the register is printed, contains individual attendance records, monthly totals, year-to-date totals, average attendance, average membership, percent attendance, and the like. Since NEEDS continually updates this tape and keeps it on file, the inclusion of attendance data in the data base whenever a need for them arises is a simple matter.

We have asserted in previous chapters that a data bank is neither a single location nor even an entity in the sense that it is defined by the presence of particular data which are in machine readable form and which are archived and catalogued. The case described here relating to whether or not we decide to include attendance data in our files points up a second and equally significant fact: the data base itself need not be construed in terms of location, but, in fact, may be looked upon in terms of availability. If a state department of education collects data on schools throughout the state, for example, the data can very well be housed by them as by anyone else. If the relationship between the state department and other members of the data bank exists and is of the kind advocated in this report, then the data base can be considered to contain those school data. The emphasis shifts from one of possession to one of access, and, of course, when one postulates availability as the central notion the data base becomes the identification of resources and the data bank becomes the processor of commitment underlying these resources.

The following is a list of some of the major computer programs used at NEEDS as part of its operating system for attendance accounting:

No.	NAME	FUNCTION
F65	Pupil Attendance Accounting	A tape oriented system which creates, edits, maintains and displays on special state approved forms a Massachusetts attendance register. Generates input for report card system. Carries non-member figures for end-of-year state report.
F111	End of Year Report	This program is used in conjunction with F65. The summary tape produced by F65 is scanned and the following figures are calculated for each grade: student count, average attendance, average membership, aggregate attendance for boys, girls and total, and the days in session. These figures are not only displayed for each grade, but also totaled in two sets of counters. One of these sets of counters will always be printed out at the final run showing summary information for the entire school (the report is generated for each grade, school by school). The other set may be printed out and cleared to produce any specified subtotal or sets of subtotals that the program parameter card specifies.
F59	Manchester, Connecticut Attendance	Processes special Connecticut format cards and generates NEEDS report card system summary cards.
F73	Connecticut End of Year Form 1A Calculation	Calculates end of year attendance statistics using special Connecticut format cards.
F98	SATIRE Program for Punching Attendance Files	This is a SATIRE source program which generates a new file of attendance cards each month for use in mark sensing.

Test Scoring and Analysis

The Board of Directors of NEEDS has developed a policy on test scoring and analysis services designed to supply more useful information and services to member schools without adversely competing with commercial test publishing agencies. This computerized system can handle most commercial tests and, within reasonable limits, any teacher-made test. The system may score tests and supply a wide variety of output including item analysis, lists of student scores showing local and national standings, local frequency tables, gummed labels suitable for transfer to permanent record documents, and the like.

There was considerable discussion at the Conference of University Educational Research Specialists (see Ch. 1) concerning the storage of test data. Some participants argued for the retention of scores and attendant statistical summaries, while other researchers advocated a more "microscopic" collection of such data. Since we feel it somewhat premature at this preliminary stage of development to establish a policy regarding the storage of subscores and summary statistics, arrangements have been made such that once a test has been processed the NEEDS data base will receive a tape file containing the individual item responses. In this way, individual scores, statistical summaries, and item clusters can be formed when desired. Some of the commercial tests used most by the NEEDS member schools, and therefore those we expect to be stored, include: Iowa Tests of Basic Skills, Cooperative English and Mathematics, SCAT, STEP, Kuhlmann-Anderson, Otis Beta and Gamma, and DAT.

One of the most significant developments within the NEEDS Test Scoring and Analysis system has been the creation--by Victor Oppenheimer, the Director of Operations Research and Development, and his staff--of a series of programs for the 1401 which makes it possible for NEEDS to process practically any test. The three programs which form the heart of the system are written to accept parameter cards at execution time. However, these parameters--which specify such things as output format, items comprising subtests, desired calculations, and relevant combinations and weightings of responses or subscores--are not treated in the conventional way. A parameter card, when read, causes a series of machine language instructions to be placed in core storage and subsequently to be executed. The result, of course, is that the parameter entries are treated by these 1401 programs as statements of a compiler language. Given a test to be scored and analyzed, it is possible to compose a set of simple statements, which may be construed as a computer program, to perform the desired calculations and to produce the desired output. The names given to these three programs are ALVIC, SATIRE, and FAD. The flexibility introduced by the use of these programs, which are briefly described in the list below, is considerable and is the source of NEEDS' test scoring and analysis capability. The following is a brief description of the major programs used as part of this system:

No.	NAME	FUNCTION
F92	ALVIC. Variable format Test Scoring, Editing and Analysis Program	To score teacher-made and nationally published tests comparing student response cards with pre-punched key cards containing correct answers. It is able to generate raw scores according to pre-specified formulae and also produces an item analysis. This program is tailor-made to a particular test by the inclusion of parameter cards written in a compiler-like language.
F98	SATIRE (Statistic and Testing Information Retrieval Encoder)	Display of test results on listings and gummed labels. This program will take card or tape input and output. Publishers and local norms tables are referenced from the 1311 disk file. This program also uses compiler-like parameter cards.
F107	FAD (Frequency Analysis and Display)	This program will generate local norms tables for both teacher-made and nationally published tests.
F99	Norms Table to Disk	This program pre-stores on disk files publishers norms tables for use in referencing with F98.
F27	Binary/BCD Card to Tape	Pre-stores test scoring input records for the series of NEEDS 7090 test scoring programs.
N33	DAT Differential Aptitude Test Forms A and B	Scores and norms all sub-tests of the Differential Aptitude Tests on the 7090 using an input tape built by F27.

NEEDS Data Base

We have asserted that NEEDS' data base--that storehouse of data associated with the NEEDS educational data bank--is not defined either by that which is a byproduct of NEEDS operations or by that which is physically stored on the NEEDS premises. This fact makes it difficult to produce a detailed catalogue such as that provided by Project TALENT, where the data base is relatively stable and where individuals may receive *ad hoc* statistical summaries of particular data. The NEEDS data bank is not, in this sense, service-oriented. However, in order to provide a clearer picture in this report of the present status of the NEEDS data base, we shall describe in some detail the contents of the tape files presently stored in the library at NEEDS.

The files contain data of three categories: report card data, test data, miscellaneous data. The following outline describes each of these sets.

(a) Report card file

1. Description. Data exist in this file for each student enrolled in a senior or junior high school for which grade reports were produced at NEEDS. For the academic year ending June 1965--the first year for which grade report data are stored--approximately 55,000 students were processed. For succeeding years we expect a 15-20% increase per year in the number of students processed.

2. Contents. Although there is some variation from system to system, the report card tape file of a given school essentially contains the following data for each student:

Student Information

Student ID number
Name
Sex
Date of birth
Year of graduation
Street address and zone
Telephone number
Parent's initial
School ID number
Homeroom
Counselor number
Previous credits

Course Information

Course description
Course number
Teacher name
Teacher number
Curriculum level of course
Course section number
Meeting time
Room number
Grade point average weighting factor
Course credits
Grade for each quarter
Addition grades (midyear, final, average)
Comment (student attitude, deportment, etc.)

Attendance Information

Days absent
Days tardy
Days dismissed
Non-member days
Days present
Days in school year

(b) Test file

1. Description. Beginning with the academic year 1965-66, all tests scored and processed at NEEDS will be stored in item-response form in the NEEDS data base. Since the test scoring and analysis system has been redesigned recently, we expect the first year to provide test data for about 20 to 30 test administrations only. The following year should produce a substantial increase in this number. The tests presently on file are of three types: (i) those administered to an entire class in a school system; (ii) those administered to a sub-population, such as a teacher-made test for a given course or a standardized test of achievement; (iii) specially constructed tests which are part of an ongoing research project. As an example of this latter category, we have on file tests administered as part of Harvard Project Physics.

2. Contents. Each test file contains the following data:

General Information

Title of test
School or Project for which test was administered
Two copies of key cards used to score the test
Date of administration
Year of graduation or other identifying information of test population

For Each Student

Student ID
Name
Sex
Item responses

(c) Miscellaneous file

1. Description. Within this category are several distinct files which are associated with a specific research project in progress or which are not sufficiently comprehensive to warrant separate listing at this time.

2. Contents. The contents of the more developed of these files will be outlined below, although only in a general way since many of them are in the stage of being accumulated.

Harvard Alumni Questionnaire File

An extensive questionnaire was distributed recently to approximately 8,000 graduates of the Harvard Graduate School of Education. Responses to this survey are stored at NEEDS in machine readable form and are being evaluated by members of the Alumni Office. Along with all the usual items one would expect to appear in such a questionnaire--name, address, occupation history, salary, further schooling, and the like--there were included items calling for an evaluation of the graduate programs, methods, facilities, etc. of the Harvard Graduate School of Education.

Rhode Island Teacher Certification File

NEEDS supervises, for the Rhode Island state department of education, a system for processing teacher data files--containing for each teacher such information as degrees, course work, experience, and subjects taught--to produce a list of each position for which a given teacher is qualified. This file is presently being included in the NEEDS data base.

Massachusetts School Statistics File

In cooperation with the Massachusetts state department of education, NEEDS has available the tapes from which the yearly state school statistics report is printed. The 1963-64 tape is the first year on file. As a subset of these data, NEEDS has on file the state aid calculations for Massachusetts based on the 1963-64 data, plus historical files on state aid allocations.

Statistical Program File

Copies of source and object programs for statistical analyses are on file at NEEDS, including a comprehensive set of programs developed by William Cooley and Kenneth Jones (Cooley & Jones, 1964) for multivariate statistical analyses.

The relationship between the research division of NEEDS and the other three divisions--which deal in one way or another with data processing services--is sufficiently close that a natural channel exists through which data which are the byproducts of NEEDS services can flow into the NEEDS data base. Naturally, therefore, as the scope of services rendered by NEEDS expands to include such other activities as cumulative record keeping, administrative data collection and processing, and the like, the amount of data available as residents of the data base will increase. Furthermore, the data base will grow as the EDB proceeds to facilitate, and thereby to foster, cooperative research efforts. But, neither the development of the data base nor the use of its contents will be indiscriminate, and it is in this regard that we recognize the importance of a well-formulated policy statement.

The preliminary establishment of an EDB requires the development of two mechanisms: that of data acquisition, and that of institutional cooperation. It is to the construction of these two mechanisms that we have thus far directed our efforts, recognizing fully that these were merely first steps. Throughout this formative period, therefore, questions of selectivity and of regulation were entertained in the broadest terms only, without regard to the specifics of eligibility of either a datum or a researcher.

Our efforts for the comprehensive development of a regional educational data bank and its attendant base of data--a stage to which we direct ourselves at the completion of this investigation--will begin with a consideration, in greater detail, and an enunciation of the rules which are to govern the conduct of data bank activities. Until that time, although the creation of data files will continue, access to the data base will be necessarily limited.

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APPENDIX A

DESCRIPTION OF FOUR DATA CENTERS

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Data centers exist in a variety of forms and stages of development throughout the country. Command control centers, for example, serve the military establishment as storehouses of data relevant to the conduct of war, while commercial data networks have been devised to perform functions ranging from airline reservations and control to financial accounting and record keeping. These and other such centers represent efforts to systematically collect and meaningfully process enormous amounts of data heretofore unmanageable or of limited usefulness.

Within the field of education, the establishment of data centers has progressed to a point where it is now feasible to pose research questions requiring many measurements on large samples, although at present not all of these educational data collections are fully developed or widely used.

Those educational data centers which have been developed to date, for convenience, may be considered to be of three types--archives, clearinghouses, consortia--although most of the larger, better developed ones, such as those described in detail in this appendix, possess aspects of each type and, therefore, are not easily classifiable in this way.

Archives are essentially storehouses of data--data bases--generally associated with a large project or designed to facilitate research in a particular area by providing access to a comprehensive data file. Such a data base is the Basic Educational Data System of the U. S. Office of Education. This repository was begun in 1963 when the U. S. Office of Education and the state educational agencies undertook--with the support and under the recommendation of the Committee on Educational Data Systems of the Council of Chief State School Officers--the joint development of a national data center. The goal of this agency is to develop a set of machine-useable records of data representing each State from each level of the educational enterprise starting with the classroom and going up through the state department of education. The directors of this project, although they have experienced certain difficulties with such problems as comparability of data and formatting, expect that extensive amounts of data will be available for research in the near future.

A second example of an educational data base is one that has existed for some time at the Student Counseling Bureau of the University of Minnesota. This data archives consists, for the most part, of the information accumulated for the past thirty years from Minnesota's state-wide and University testing programs. These data, which are available for recent years on data processing cards or tape, have been used for long-term followup studies, studies of trends and changes, and the like.[1]

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[1] Personal communication from Professor Ralph F. Berdie, Director of Life Studies, University of Minnesota. For further information concerning the availability of data, contact the Director of the Student Counseling Bureau.

Clearinghouses, a second type of data center, have as their concerns the accumulation of all material relevant to a given research domain and the establishment mechanisms for the dissemination of such material. They differ from archives in that they are more gregarious; storage is merely a means to dissemination which is their main interest. An excellent example of an educational research clearinghouse is the Center for Interest Measurement Research at the University of Minnesota. This center, which is under the direction of David P. Campbell, was established in 1963 with the following goals: "(1) to maintain an active research program in interest measurement; (2) to serve as a focal point for information on related research conducted in other places; and (3) to serve as a repository for basic data on interest measurement."[2] Impetus for the development of this center was provided by the donation to the University of materials of the late Professor E. K. Strong relating to his work on the Strong Vocational Interest Blank. Campbell states that "with the receipt of these materials went the implicit recognition that Minnesota would serve as the clearing house for matters related to the SVIB."[3] The center engages in such activities as the revision of the SVIB, the conduct of occupational research, the maintenance of an occupational interest file of famous persons, and the dissemination of information relevant to occupational interest research.

The Association for Educational Data Systems (AEDS) under a grant from the Fund for the Advancement of Education has established the AEDS National Center to serve as a clearinghouse for all pertinent information in the area of educational data processing. The activities of this center will range from the establishment of a professional placement service to the creation of a program to underwrite the expenses of making data processing consultants available to local school systems. However, the central function will be that of dissemination similar to that of the Minnesota Clearinghouse.

The third type of data center is the consortium which comes closest to resembling a data bank as proposed in this report. While the consortium is often concerned with research and with dissemination, its major concern is to foster communication among individuals and their institutions in order to encourage joint research or coordinated research on problems in a given area. One such educational consortium is the Inter University Communications Council, Inc. (INTERCOM) INTERCOM, a non profit corporation directed by Dr. William N. Hubbard, Jr., University of Michigan, was formed to provide universities with an effective means of collaboration on the study of communication made possible by computers and data processing techniques. Task forces, consisting of individuals from the member institutions, have been created to carefully examine such areas as information networks, educational systems and technology, and continuing education. The work of this group is significant, not only in terms of the information it will provide, but also in terms of the model it provides for the functioning of an educational data bank.

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[2] D. P. Campbell. Research frontier, the Center for Interest Measurement Research. *J. counseling Psych.*, 1964, 11, 395.

[3] *Ibid.*

The foregoing introduction is brief indeed and hardly adequate to do more than suggest the concentricity of concerns which exist among archives, clearinghouses, and consortia. In order to provide a clearer picture of the operation and organization of data centers four large scale, operating systems will be described. These systems embody most of the basic notions inherent in a data bank.

The content of the descriptions draws heavily upon the extensive literature published by each center and upon private consultation with members of the organizations. While inaccuracies are clearly the responsibility of the authors of this final report, the basic information contained in this appendix is attributable to the respective staff members of the projects discussed. It is recommended that further information be obtained by either corresponding with the individuals involved or by making reference to the appropriate publications listed in the bibliography of this report.

PROJECT TALENT

Project TALENT emerged from an awareness on the part of its developers of a need to conduct a comprehensive aptitude and ability inventory of the nation's secondary school students. They felt that if the nation's human resources were to meet with success the demands of a dynamic, affluent society, it was of the utmost importance to identify the talents of the nation's youth. Such a national inventory would allow schools to plan more accurately, and would assist them in developing the potentials of students with a greater degree of assurance and certainty. Included in the Project would be a study of the nation's secondary schools.

In 1957, preliminary plans were developed at the University of Pittsburgh by the Institute of Research in Education for a long-range, large-scale educational research project involving a five-percent sample of the nation's secondary-school population and 1,300 schools. It was estimated that approximately 440,000 students attending grades nine through twelve would be involved.

During 1958, the Cooperative Research Branch of the U. S. Office of Education, the National Institute of Mental Health, the Office of Naval Research, and the National Science Foundation lent their support to the development of the Project's operational plans. The first year of Project TALENT was devoted exclusively to the development of a battery of tests and other instruments for collecting data.

Besides the Project staff, the organizational structure includes four advisory panels under a general chairman. The panels, which include specialists, are: (1) Guidance and Counseling, (2) Educational Research, (3) Testing Problems, and (4) Manpower and Sociology. The plans developed by these four panels are reviewed by an Advisory Council. Also, Project TALENT works in close cooperation with the Research Advisory Committee of the Cooperative Research Program of the U. S. Office of Education.

The plans of Project TALENT called for:

1. A testing and information-seeking program to obtain data in areas of aptitude, ability, achievement, and interests, as well as demographic and biological information.

2. Collecting information on a sample of approximately 1,300 secondary schools that would yield the significant characteristics of secondary schools on both the 8-4 and 6-3-3 systems.

The selected sample of high school students was given a two-day series of examinations during March and April of 1960. This inventory was conducted to coincide with the 1960 population census. The cooperating schools also completed questionnaires which sought information on school and guidance programs.

Project TALENT also includes provisions for follow-up studies in addition to the initial testing period of 1960. It will attempt to determine what the students involved in the initial sample are doing one, five, ten, and twenty years after graduation from high school. The data provided by the follow-up questionnaires will be added to the information for each individual student. This plan will provide a continuing record of the activities of each student for a period of twenty years. The objectives of Project TALENT can be delineated as follows:

1. Develop an inventory of human resources which will identify the capabilities of the nation's youth. This goal will be accomplished through an extensive test and questionnaire program.

2. Develop a set of standards for educational and psychological measurements. The data collected will make available a set of reliable values for standardizing tests.

3. Develop a comprehensive counseling guide indicating patterns of aptitude and ability which are predictive of success in various careers. The data obtained from the initial study and follow-ups will allow attempts to develop measures for accurate prediction of success.

4. Develop a better understanding of how young people choose their life work. The follow-up studies should provide insights regarding factors which are the most significant in influencing the students' decisions, as well as information concerning success or failure in their work.

5. Develop a better understanding of the educational experiences which prepare students for their life work. The information derived from the study will serve as a basis for developing basic policies regarding the utilization of manpower.

6. Develop a data bank that would serve as a source of data and information for future research studies in the problem areas of education. The data on file on tapes at the University of Pittsburgh are now available to any qualified researcher.

The activities of Project TALENT include:

Follow-up studies: One major activity of Project TALENT is the collection of additional data through a series of 16 follow-up studies. All the one year follow-up studies have been completed and the first five year study was mailed in the spring of 1965. The last twenty year follow-up will be in 1983. It will canvass the graduating class of 1963 that was the freshman class when the initial testing was conducted in 1960.

Project TALENT makes two major kinds of reports: (1) Scores to cooperating schools, and (2) Reports to the nation's schools, educators in general, and parents on the identification, development, and utilization of human talents and resources.

Project TALENT has prepared five additional major reports on the work of the study. The first two describe the basic plans for the study and the instruments used in it. The third summarizes the information obtained about

American high schools. In most cases the school served as the unit of analysis. The fourth report concerns information regarding the achievement and characteristics of a sample of 15 year-old youngsters. This group included students as well as those not attending school. This group represents a large sample of American 15 year-olds. The fifth publication presents a detailed report about the achievement, aptitude, interests, and personality characteristics of American high-school students. This report summarizes the most significant aspects of the data and points out their importance.

Project TALENT offers two types of data base services:

1. It will perform specific analyses of data in file at the base upon request following the specifications of the individual researchers. That is, Project TALENT will be able to perform analyses as specified by the investigators.

2. It will conduct research studies or investigations under contract. Individual researchers or organizations may contract Project TALENT to perform research studies or investigations. Under this type of arrangement the staff of Project TALENT would draft the design and specifications of the study, analyze the data, and prepare the reports of the study.

The charges that will be made for services requested will be based on computer time used in performing the service, plus time-cost for the services of personnel such as programmers, data coordinator, and others. Those requesting analyses will be sent an estimate of costs which will constitute the actual price to be charged. Users of the data must provide the organization with two copies of any report generated from the use of data obtained.

Users of the data base may specify a number of statistical analyses such as analysis of variance, canonical correlations, multiple contingency analysis, and the like. In addition to the programs in Project TALENT's statistical library, the programming staff is available for developing programs as specified by the researcher.

Project TALENT tests and information-gathering instruments are available to qualified researchers. The tests, however, should be used for the purpose of calibrating other tests or for studies with interests similar to those of Project TALENT. These tests will be made available on a loan basis and a fee will be charged to cover handling expenses. Users may reprint the tests and answer sheets upon consent of Project TALENT. The scoring of the tests, however, is the responsibility of the investigator.

During March and April of 1960, Project TALENT administered the following tests:

1. Information Test--which collected information concerning knowledge acquired in school as well as out of school producing 38 separate scores and one composite

2. Language aptitude and ability Tests--which included such areas as memory for sentence, English usage, word functions in sentences, etc., producing 10 separate scores and one composite

3. Complex Intellectual Aptitude Tests--which tested specific aptitudes in creativity, mechanical and abstract reasoning and visualization, producing five separate scores

4. Mathematics Test--which included arithmetic reasoning plus introductory and advanced high school mathematics, producing three separate scores and three composites

5. Clerical and perceptual aptitudes--which included object inspection, and table reading, producing four separate scores.

In addition to the tests three questionnaires were administered, including:

1. Student Information Blank, which collected data on hobbies, health, father's occupation, plans for college, etc.

2. Interest Inventory, which measured interests in such areas as office work, sales, labor, art, etc.

3. Student Activities Inventory which obtained information on the traits of students as revealed by self reports on behavior and attitudes.

Each student was also asked to write one paragraph on "my views about an ideal occupation," and another one on "what high school means to me."

A School Questionnaire was designed to provide information regarding average age, years of teaching, degrees held, etc. of the faculty and the principal of the school. Also included were questions about the type of school, grades, accreditation, grading system, pupil-teacher ratio, etc., and the community background of the school. Questions were asked about extra-curricular activities, advancement policies, and school curriculum.

Counselors filled a Guidance Program Questionnaire concerning the nature of the guidance facilities of the school and the nature of the service. Guidance personnel were also asked to provide information about the types of tests administered, the nature of the problems brought to them, and the kinds of help offered. The questionnaire sought information about their level of education, experience, job duties, etc. In addition counselors provided solutions to hypothetical guidance situations.

Project TALENT is not an experiment in the sense that it attempts to try out or to prove new theories. Rather, it is an attempt to conduct a detailed and scientifically designed study of human talents, aspirations, needs, and interests using as a target a representative segment of the nation's school population.

The information obtained from this study is intended to provide a reliable and easily accessible base of data for use in the formulation of educational and manpower policies in the future and for bringing to light a number of new facts concerning the nation's youth that will help the advance of research.

THE IOWA EDUCATIONAL INFORMATION CENTER

In 1963 the College of Education of the University of Iowa with the support of the Measurement Research Center (MRC) and the State Department of Public Instruction developed a pilot program in educational computer services for 12 secondary schools in Iowa. The results of the pilot program provided encouragement and impetus to the idea of a centralized information center, and subsequently the Iowa Educational Information Center (IEIC) was formally created at the University of Iowa under the auspices of the College of Education and the State Department of Public Instruction.

The IEIC operates with grants from the United States Office of Education and the Ford Foundation. The IEIC makes use of MRC's data processing equipment and is administered by a Director, Associate Director, and a three-member Coordinating Board.

The primary objective of the Iowa Educational Information Center is to improve education through the application of modern data processing methods and computer technology. It is expected that the Center will be able to:

1. Provide the State Department of Public Instruction with different types of information regarding school personnel, salaries, teacher certification, tenure, degrees, administrative policies, and student populations. The Center, with the introduction of the *Iowa Card Pac System of Educational Accounting*, will serve as an information collection and processing agency for the Iowa State Department of Public Instruction.

2. Develop a testing program for reporting to school systems individually and to the State Department of Public Instruction statewide. The testing program will make it possible to provide individual school systems with annual analysis of their teaching.

3. Develop a testing program that will provide a cumulative file for individual students.

4. Serve as a clearing house for school systems and personnel.

5. Serve as an instrument in facilitating educational research, particularly in longitudinal studies concerned with pupil development.

6. Provide individual high schools with programs in scheduling services, grade reporting, attendance reporting, inventory control, bus routing, and building utilization.

7. Serve as a model for the development of information centers in other states.

8. Facilitate communication and promote cooperation among school systems and the State Department of Public Instruction, and within the school systems themselves.

The services that will be made available to individual school systems will make it possible for them to do such things as:

1. Analyze and project bonded indebtedness programs and determine fiscal needs and proposals based on economic trends and educational demands.

2. Make meaningful and sound policies and policy changes.

3. Assess themselves in terms of school achievement and general level of excellence.

IEIC is developing a system for the systematic, large-scale collection of educational information dealing with all phases of the educational program. It collects data on such various areas as: pupils, teachers, counselors, administrators, school board members, curriculum, parents, administrative practices, physical plant, etc. IEIC is also developing a centralized educational information file, where collected data are transcribed to magnetic tapes. As new data are received they are organized, categorized, merged, and integrated into existing data. The file thus organized will be kept continually up to date. This file serves as a source of information and data to schools, educational agencies, and individual researchers.

The IEIC has incorporated into its standard operational procedures a program for the training of personnel in the use of electronic equipment and systems for educational purposes. The Center will offer pre-service and in-service programs for school personnel who make use of the services of the Center.

In April, 1965, the IEIC initiated the use of the *Iowa Card Pac System of Educational Accounting* for the collection of educational information. This system enables schools to make almost all reports to the Center and the State Department of Public Instruction through packs of check-list IBM-type mark sense cards. These cards are filled out by school personnel, faculty and students, as the case may be, and sent to the Center for processing.

From these data the Center will prepare a "Personnel Report" for the Superintendent's office, a "Student Body Characteristics Report," and a "Student Information Report" at the end of the school year. These reports are forwarded to each school and the office of the Superintendent. Partial reports which consist primarily of cumulative record data are sent to the schools between semesters.

Not all the data to which the Center has access will come from the Card-Pac project. The Center has maintained files on the results of the Iowa Tests of Basic Skills and the Iowa Tests of Educational Development. These tests are administered to almost the entire population of the State of Iowa in grades three to twelve. In 1963 over 400,000 students took these tests.

The reports, which are made by the Center to school systems and the Office of the Superintendent, analyzing and describing group characteristics, include items such as occupational and educational goals and aspirations, reading interests and habits, distribution of grade point averages in relation to tested achievement, indices to socio-economic status, and the like.

One of the most important functions of IEIC is to analyze, summarize, and refine the data it collects and make them available to cooperating institutions in various forms. Institutions will be provided with cumulative records of individual students which may be utilized in guidance or for a number of other purposes. IEIC will also make available analyses of trends, needs, and characteristics of school populations and personnel.

Schools may avail themselves of such services as class scheduling, grade reporting, building utilization inventories, and attendance accounting. These services are part of the UPDATE services of the Center. During 1964-65, fifty-five schools availed themselves of the UPDATE services. In addition to these services, other services such as enrollment predictions, ability grouping, bus route scheduling, financial accounting procedures, and census analysis are being developed and will be made available in the future.

IEIC is engaged in developing more efficient and effective educational data processing techniques. These techniques will be made available to local school districts who have acquired data processing equipment for clerical tasks. The techniques that will be made available to school districts will allow them to utilize their equipment more effectively and efficiently.

Although there are a number of school districts who have acquired data processing equipment and the number is constantly increasing, this condition does not minimize the need for regionalized data processing services. An organization such as the IEIC can provide school districts without data processing equipment with the advantages of data processing services and all districts with larger and more specialized equipment than they could independently acquire. IEIC is developing processing techniques that presumably will be flexible enough to meet the varied needs of individual school systems.

INTERNATIONAL PROJECT ON THE EVALUATION OF EDUCATIONAL ACHIEVEMENT

The International Project on the Evaluation of Educational Achievement (IEA) is a study designed to conduct cross-national studies with the purpose of obtaining objective measurements of educational attainment. IEA is not limited to the task of developing a long-range series of cross-national researches using instruments specifically designed for that purpose. One of the primary objectives of the project is to foster cooperation at all levels through the pooling of talent, knowledge, and the interest of a common enterprise. The task of developing a systematic study of educational outcomes in the school systems of the cooperating countries is merely a prerequisite to the attainment of continuous collaboration, pooling of information, and the establishment of a strong organization that would coordinate the efforts of the cooperating countries.

Continuous cooperation, however, is a prerequisite to a more fundamental goal--better education throughout the world. IEA will allow educational systems to place themselves under scrutiny and diagnostic comparisons that will serve to develop searching evaluations which hopefully may lead to improvements and continuous progress.

The attainment of this last goal is contingent upon a number of variables, particularly two: (1) The development of examinations of a reliable and objective kind which will permit measurements of the degree to which objectives are attained, and (2) The degree to which the founders of IEA will be able to bring nations to join the project and cooperate.

In 1958, Arthur W. Foshay, Executive Officer of the Horace Mann-Lincoln Institute of School Experimentation, Teachers College, Columbia University, presented to the UNESCO Institute for Education the proposal that it should explore the possibility of establishing an "International Study of Intellectual Ability, Achievement, and Functioning of Children of School Age." The UNESCO Institute accepted the proposal, and in June, 1959, invited for a meeting in Hamburg, Germany, representatives of 13 centers of research which in the past had worked together in projects similar to the study conceived by Professor Foshay. Representatives of Belgium, England and Wales, Finland, France, the Federal Republic of Germany, Israel, Italy, Yugoslavia, Poland, Scotland, Switzerland, and the U. S. A. attended the meeting. At this occasion Arthur W. Foshay was appointed Project Director.

At this meeting it was decided to develop a pilot project to explore the possibility of implementing the ideas of Professor Foshay. At a second meeting in 1959, the participants decided to extend the IEA study into a considerably larger project encompassing long-range series of cross-national researches using instruments designed by IEA. In the meantime the pilot project would proceed to test and evaluate the machinery that had been developed for the purpose of fostering cooperation between widely scattered groups in Europe, the Middle East, and North America. Two other tasks of the pilot project were: (1) To search among the participating nations for technical and intellectual resources and decide on the best way to use them, (2) To pinpoint the research problem areas that would be met in carrying out the project.

A meeting was called on October, 1960, in Hamburg to explore the possibility of carrying out the project. This meeting was attended by delegates of eight nations plus representatives of UNESCO. At this meeting the delegates were able to delineate the aims of the project more precisely, write detailed test specifications, identify populations, determine sampling procedures, and set up the administrative and financial machinery.

Another important decision at the 1960 meeting was that it determined that the initial phase of the research effort would be concentrated on studying the last few years of formal schooling and that it would be done in one subject only--mathematics.

As of April, 1963, ten countries were participating as full members with two countries, Canada and New Zealand, participating as associate members. Australia, Greece, Norway, and Western Germany had expressed their desire to join the project. By February, 1964, IEA listed Belgium, England, Finland, France, Israel, Japan, Netherlands, Scotland, Sweden, and the U. S. A. as full members and Australia and Germany as associate members.

As its title implies IEA is an organization of international character organized and administered by research experts in the field of education. The founding members constituted themselves into the Council for International Evaluation of Educational Attainment. This Council serves as the governing body of the study and is open to additional members as they become full members of the project. Two kinds of memberships exist: (1) Full members, and (2) Associate members, who are not allowed to participate in the selection of content for measuring instruments.

A Standing Committee is responsible for implementing the policy decisions of the Council, and has the power to make interim decisions in the intervals between Council meetings.

The UNESCO Institute for Education at Hamburg supplies administrative and technical coordinating services for the project. It supplies a Coordinator who has executive responsibilities for the scientific and administrative organization of the study. The Institute also has the responsibility for organizing meetings of the Council, Standing Committee, and any other committee appointed by the Council.

At the national level, the machinery that has been established for the development of tests is the following:

1. Experts in each country assemble relevant material that specifies subject attainment for students in the 13 to 17+ age range.

2. The reports prepared by the experts are forwarded to one individual who is responsible for preparing a working paper.

3. The working paper is submitted to national experts for evaluation and comments.

4. The revised working papers are then submitted to subject matter experts and test experts who produce the first draft of the test.

5. The first draft of the test is submitted to national experts who field test it with selected sub-groups.

6. After the first draft has been field tested a committee of experts prepares the final form of the examination.

IEA is financed by a grant made by the United States Office of Education. The grant was made to Teachers College, Columbia University, and the University of Chicago jointly. The funds are specifically for administration and coordination, international meetings, consultants, the printing of tests, and data processing. Not included in the fund are expenses for work conducted within countries (administering tests and questionnaires) except within the U. S. A. The UNESCO Institute will accept subcontracts to perform research of an international nature closely akin to the interests of the study.

In order to evaluate educational achievement IEA felt it would be imperative to answer a number of basic questions, restated in the form of hypotheses, if it were to achieve its goals and gather meaningful data.

In formulating the hypotheses the Standing Committee, guided by recommendations from several hypotheses committees, took into consideration these concerns:

1. The international nature of the project should not be subordinated to interests of national character.

2. The collection of data should be kept to a minimum.

3. The testing of formulated hypotheses should be of primary interest.

The several hypotheses were grouped into six classifications designed to serve also as the set of concepts which would encompass the interrelating ideas in the study.

1. Values and philosophies. It is considered that each country has unique values and philosophical outlooks which are intricately related to man and his society.

2. Policy. Each country attempts to express its values and philosophy for the society it attempts to foster or establish through the policies it develops and enforces.

3. Educational practices. Each society attempts to perpetuate its values and philosophy for the good society by shaping educational practices so that what is taught, and the manner in which it is taught, will reflect its policies.

4. Cognitive learning outcomes. IEA attempts to determine the manner in which students have learned mathematics, as well as measure how much they have learned.

5. Affective learning outcome. A central concern of IEA is to determine the interests of students in learning mathematics and their attitudes toward it.

6. General attitudes and values. IEA assumes that some of the results of being exposed to education, particularly 4 and 5, can be attributed to educational practices. Other attitudes and values, while they may be related to educational practices, are not so easily attributable to such practices. While this is a most difficult area to measure, IEA attempts to estimate it and has evolved a number of hypotheses which involve relationships between this area and the others.

In addition, the committee suggested that the source of data to be used in testing the hypotheses should include

1. Mathematics achievement test
2. Student Questionnaire
3. School Information
4. National information; national case studies

All data gathered by national centers will be sent to Chicago for processing. It will arrive in the form of answer sheets, or punch cards. Data in answer sheets are processed by an IBM 1230 Optical Mark Scoring Reader which transfers the information to punch cards.

The initial steps in the treatment of the data by the IBM 7094 Computer is to organize the data and to separate them into four master files. Each file corresponds to each of the major levels to be tested. These files consist of magnetic tapes which will contain data on every student, teacher, school and report collected by the project.

"Working Tapes" will be made from the master files for everyday use of the data. These tapes, although organized in the same manner as the master files, will not contain all the responses contained in the master tapes. Instead they will include: (1) Scores rather than item responses. (2) A number of derived indices, and (3) A weighting factor for each student.

It was the decision of the Council that mathematics would be the first subject which would be used to measure educational achievement. It was decided that the test would include important topics of subject matter such as: Arithmetic, algebra, geometry, and probability and statistics, as well as different types of operational thinking and reasoning. It was also agreed that the test would not be more than six hours in length for any particular level.

The first step in the preparation of the examination was the drafting by each of the participating countries of a "national working paper" which would describe the content and objectives of the national program of mathematics instruction. The working paper would be prepared by experts in each country and then forwarded to specialists in mathematics and test construction who would prepare a preliminary outline of the test. The preliminary outline would then be circulated among the experts who prepared the "national working papers" for comments and modifications. Working from the revised outlines, test experts would prepare the first draft of the examination which would be submitted to all the participating centers for consideration. From this first draft emerged the try-out version that was field tested during the months of February and March of 1963.

IEA will supply each cooperating center with a report that will include statistics on the scores of tests (frequency distributions, measures of central tendency and dispersion). It is the policy that no national reports should be published until the "international report" appears. However, outlines of research at the national level may be made available to governments or qualified individuals of the National Centers cooperating in the program.

The four master files are available to participating centers to conduct further research, particularly in areas not covered by the hypotheses. Qualified investigators, upon approval of the Council and Standing Committee, will be permitted to use the data collected by IEA for research purposes. However, the data will not be available until after IEA has completed its analyses and reports.

INTER-UNIVERSITY CONSORTIUM FOR POLITICAL RESEARCH

Recent literature in the behavioral sciences shows a growing trend toward the development of data archives or repositories. A data archive, to be distinguished from the conventional library, or even a data bank, is a library of coded information stored in punched cards, magnetic tapes, and magnetic disks.

Aside from the obvious advantages of speedy access and retrieval of information which has been funded in machine readable formats, data archives, like data banks, are essential if new research findings and information are to be aggregated effectively to existing knowledge. The implications of such a system of continuous up-dating of existing knowledge is of considerable importance insofar as they intimate that it is possible with a large degree of accuracy and speed to gain access to all pertinent up-dated information related to a problem.

One such system of information is the Inter-university Consortium for Political Research (ICPR) which is a federation of 37 universities and the Survey Research Center of the University of Michigan at Ann Arbor. One type of information contained in the archives of ICPR is the major political surveys of the past 25 years. It also contains several kinds of nonsurvey information such as committee assignments of legislators, senatorial vote on issues, and demographic data, as well as information gathered by the Bureau of the Census.

Membership in ICPR is open to all institutions of higher learning in the U. S. A. and Canada. Institutions offering graduate work at the doctoral level in such areas as political science and government are eligible to become "full members." Institutions which do not offer doctoral degrees may join the Consortium as associate members. Educational institutions other than those in the U. S. A. and Canada may be admitted as associated members. The most significant difference between both types of memberships is that students who belong to associate-member institutions and who wish to use the resources of the Consortium are carefully screened and the number limited.

In one sense, ICPR is atypical of data archives insofar as the several repositories that make up the consortium attempt to store and retrieve information using identical formats. The archives may differ from each other in some technical aspects of input and output of information, hardware used, purposes for storing information, and in areas within the behavioral sciences from which information is collected; however, they are similar to the extent that basically they are information-retrieval systems that should be able to "answer" a broad range of inquiries.

A fundamental characteristic of retrieval processes in data archives is that in order for information to be retrieved with some degree of effectiveness and accuracy, it is imperative to develop a "book" or dictionary of descriptor items for each variable or related variables of the information contained in the archive. The development of one such dictionary that could be used by a large number of archives, eliminating the need for a separate dictionary for each archive, is perhaps one of the most significant contributions that ICPR could make toward the systematization of information retrieval. These descriptor items may be described as "tags" that will identify specified variables. Tags may carry varying degrees of generality which once compiled form a dictionary. The tag is in effect one specification, or a set of specifications, for retrieval. In turn, it is a component of a more comprehensive set of specifications. These specifications delineate variables in the most discrete manner possible so as to minimize semantic ambiguities.

ICPR as a data archive is unique insofar as it is not one data repository, but a number of archives grouped in partnership. This consortium has as a major goal the development of better lines of communication and cooperation among the data archives that comprise the system. Although the several archives are not located in one central place and requests for information are not processed in one central locale, but sent directly to the pertinent archive, the uniformity of operational procedures adopted by the members of the consortium simplifies communication and, as a result, research. The adoption of uniform procedures for input and retrieval of information allows the use of one format, in theory, for the retrieval of information from all the archives in the consortium.

A data archive is similar to a conventional library in the sense that information concerning a given topic could be found in a number of places, and that in order to compile all the relevant information on it a meticulous search must be conducted. This type of search is often time-consuming. In this sense a data archive offers a decided advantage over the conventional type of library since the method of information retrieval employed by a data archive obviates the necessity to spend long periods of time locating and compiling by hand information related to a given inquiry. The computer is able to search every source of information which may conceivably contain information related to the inquiry and, in addition, will provide a print out of sources of the desired material. The speed with which the computer scans through the specified material makes it possible for the researcher to be as comprehensive as he wishes in his search for information.

In contrast to a data base such as Project TALENT where the location of every bit of information is known, and it is possible to gain direct access to a given item without having to search through a large corpus of information, the data archive contains general areas where information may be located. In the data archive the computer searches through the specified material and extracts those bits of information that it has been instructed to locate.

The use of tags for the retrieval of information that was described above has a number of advantages that are being studied by ICPR. The system of tags permits a rather broad limit as to the number of items by which data may be identified. The implication is that this flexibility reliminates the necessity to arrive at a rigid scheme of classification. A rigid scheme of classification requires a number of arbitrary definitions which automatically reduce the flexibility of the scheme. The tags should be of importance to all users of the archives.

Such a dictionary must be for general use. However, there must exist a number of dictionaries which list tags more relevant to some areas than to others. These could be considered as special-interest dictionaries.

Tags could be written either in natural or artificial languages--that is, the tag for "knave" or "scoundrel" could be the natural word "dog" or the abridged version "dg." However, if the system of tags is for the purpose of enabling users of the archives to state requests with the greatest degree of ease, then natural language should be preferred in the preparation of tags.

In addition to the dictionaries of tags ICPR is developing lists of "standard questions." These lists contain almost every question that has been asked by the studies in the archives. They are organized into such general categories as demographic, foreign policy, etc. The lists contain the name of the studies from which the questions were taken.

The uses of ICPR are such, for example, that a researcher may ask the question, "What state senators voted for Bill X?" or "Which are the studies in 1948 that gathered information regarding the income of widowed working mothers?" and the computer's response may be a list of names of state senators or a list of names of studies.

As a result the researcher may then refer to the specific sources that have been provided and ask more penetrating questions. As archives become larger the narrowing-down process becomes longer--the number of individual retrievals will increase. In the process of obtaining the desired information the researcher may have to use several program for retrieval at ICPR. Two of these are the tag dictionary and the standard question file. In addition to these the researcher will have to make use of what ICPR labels as the codebook text file and the study description file if he wants his question answered. These last two files are also search programs.

The addition of new information to the files of the archive requires the use of a different type of program. This program compares the questions in the standard question lists to the questions in the new study, rejects those from the study which are already in file and proceeds to incorporate the new ones. After the study, description and code text files are updated. The most intricate part of the process is that of providing tags for the new questions and including them in the tag dictionary.

Members of the Consortium appoint one representative to the ICPR Committee of Representatives. This Committee is responsible for developing the re-ulating policies of the organization as well as determining the activities to be conducted by the Consortium. The Committee in turn elects a five-member Council that has executive powers and is allowed to act in behalf of the Committee. The Council empowers subcommittees to carry out the activities that have been approved.

The Survey Research Center (SRC) is in charge of administering the activities of the Consortium by providing the necessary professional and technical staff and administrative services; SRC will provide aprogram director and any additional personnel that may be needed.

SRC provides data-storage facilities and the other facilities that are necessary for the reproduction and processing of data. It also provides technical consultation on sampling, questionnaire design, etc., as well as services such as data collection and processing.

The Consortium's primary responsibility is to member institutions (as institutions, or individuals within the institutions) regarding its facilities and services, and requests for services by nonmembers will be honored only if they do not interfere with the interests of the members of ICPR.

A considerable share of the Consortium's resources have been employed in the setting up of summer training programs. Starting in the summer of 1963, ICPR offered member institutions a number of research training courses such as: Introduction to Survey Methods, Cases in Survey Research, and Pro-seminar in Behavioral Research Methods. In addition to these courses the Consortium offers several courses in political science during its summer institutes.

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DATA BANK SUPPORT OF STUDENT DEVELOPMENT RESEARCH

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Federally-supported regional data banks promise to provide the educational researcher a source of data worthy of his best models and methods. Those of us who have envied Project TALENT its huge probability sample of American high school youth with its thousands of observations on the sample members and their schools are elated at the prospect of access to similarly massive hoards of data. To be worthy of the expenses involved in collecting, managing, and disseminating it, the data in a regional bank should be derived from probability samples as carefully constructed as the TALENT sample and the variables should be as carefully selected and scaled. Much thought should be given to retrieval techniques which will facilitate the drawing of specialized subsamples from within the bank. The following remarks are directed to the exposition of the role the data bank can play in support of an approach to human development research which represents a methodological innovation for the field. This new approach abandons the customary effort to account for an individual's developmental pattern from his known profile of scores on measures of individual differences. Its major methods have been statistical, with heavy reliance on linear models such as analysis of variance, multiple and canonical correlation, and discriminant analysis. Perhaps the most significant feature of these linear prediction models is that they are compensatory, since they depend on weighted sums in which low performance or status on one of the variables may be compensated for by high performance or status on another. These multivariate statistical models brilliantly capture the genius of the classical trait theory of personality with its preoccupation with individual differences on common traits and its view of personality as the sum of trait scores of an individual. Despite the existence in the literature of formidable studies such as *10,000 Careers* and the already published TALENT studies, it is fair to say that this approach has not enjoyed the thorough tests of its potential it deserves by its brilliance. Regional data banks will provide our newly computerized practitioners of these classical statistical methods the data resources required to probe for the real limits of the capabilities of the classical trait theory. However, it is not premature to ask consideration of a different approach which attempts the fitting of a mathematical model directly to the data of developmental patterns.

The kind of model I have in mind is a stochastic model, specifically of the finite Markov chain variety. Psychologists have been very successful in recent years in fitting Markov chain models to phenomena such as learning, games, policy-making behaviors, and other situations involving repeated trials over time. To the best of my knowledge, there has been no effort to fit such models to developmental sequences such as career patterns. This is surprising, since the Markov model is a genuine process model, capable of representing an on-going life process such as the development of a career.

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[1] Associate Professor of Education.

APPENDIX B

PAPERS DELIVERED AT THE CONFERENCE OF UNIVERSITY EDUCATIONAL RESEARCH SPECIALISTS

Bartlett has said of a stochastic process that it represents "some possible actual, e.g., physical, process in the real world, that has some random or stochastic element involved in its structure."[2] Markov models are probability models, and they cannot be expected to account for all of the variance in developmental patterns. They do have the advantage that they propose self-contained systems in which the predictability which is obtained is a resultant of the cynamics of the model itself, rather than being derived from external information about the state of predictor variables. A suitable Markov model can tell us how much of the variance in developmental outcomes can be explained by a theoretical model of the process itself without recourse to functional or statistical relations with outside variables. Then a remark of Anatol Rapoport's becomes relevant: "the methodological value of mathematical models is much more in the insights that come from their failure than in their successes."[3] We may have to invoke individual differences to account for residual variance the best fitting mathematical model leaves, or we may find that the real-life process is so messy that no reasonable fit of a mathematical model can be achieved, which would completely justify our traditional statistical least-squares methods. I am not naive enough to suppose that the good results obtained in the fitting of Markov chains to the data from artificial laboratory experiments involving repeated trials guarantee success to efforts to fit such chains to data from human development studies, but the time has come when we should be exploring the possibilities of achieving useful, if ill-fitting, mathematical models to clothe such data. We are working along this line at the University of Buffalo,[4] and it has already become apparent that new approaches to data gathering are indicated if Markov chains are to be attempted on such developmental data as educational or vocational career patterns. Since regional data banks represent the best hope for the collection of adequate data for this purpose, this is a good time to survey the data requirements and the potential value of stochastic models research on student development.

Stochastic models are available for continuous variables, but this discussion is confined to consideration of a particular class of such models, namely finite Markov chains, which applies only to discrete variables. Strictly speaking, a Markov variable is a nominal or ordinal categorical scale on which the subjects are observed repeatedly [but not continuously] over a period of time. Subjects may move around among the levels of the variable as time passes, so that the variable may be observed to have a different distribution at each trial, or stage, in the history of the process.

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[2] M. S. Bartlett, An introduction to stochastic processes. UK: Cambridge University Press, 1960, p. 1.

[3] A. Rapoport, A fruitful stochastic model. Contemporary Psychol., 9, 7 [July 1964] .

[4] S. David Farr, Richard L. Egelston and Silas Halperin are involved with the writer in this exploration.

If X_j is the Markov variable at stage j, the Markov chain is the simultaneous probability distribution $P[X_1, X_2, \ldots, X_j, \ldots, X_n]$. A particularly important defining characteristic of a Markov chain is that it assumes a process "with no memory extending before the previous instant."[5] That is, the values of X at any stage are assumed to depend on its values at previous stages only through dependence on its values at the last available stage. One could worry about this assumption, but fortunately a process with a longer memory can be transformed for analytical purposes to this type of process with a one-step memory. Note that the number of levels, or states, of the variable is constant over stages. If the conditional probabilities p_{jk} representing the probability of the process being in state k of the Markov variable at time or stage m given that it was in state j at time $m-1$ are arranged in a matrix, the result is the *transition* matrix ${}^{m}P$. For example, the elements p_{jk} of the transition matrix ${}^{1}P$ are the conditional probabilities of being in state k at stage 1 given that the process was in state j at stage 0. The matrix ${}^{m,m+k}P = \prod_{i=m+1}^{i=m+k} {}^{i}P$ is the transition matrix for going from stage m to stage $m+k$. The prospect of having to describe a developmental process in terms of a long string of fitted transition matrices is not very alluring, but if the further assumption of a *stationary* transition matrix P can be justified, making all one-step matrices the same, the elegant result is obtained that ${}^{0,m}P = P^m$. That is, the mth power of the stationary transition matrix P gives the transition matrix for going from stage 0 to stage m. Another elegant result is that if P is positive [has no zero elements], a finite number of transitions will yield a limiting matrix $A = P^m = P^{m+1} = P^{m+k}$. Further, all the elements of any column of A are the same, and any row of A gives the vector of *final probabilities* for the chain. These final probabilities give the distribution for the Markov variable when the process has achieved stability, and also give the distribution of outcome probabilities for any subject regardless of where he entered the chain. When the limiting matrix A exists the model is a *regular* Markov chain. The process it models eventually achieves stability, and long-range predictions are possible for all subjects who enter the process without regard to their choices of entry points. When P is not positive the chain may still turn out to be regular, or it may be *cyclic* or *absorbing*, two other types which are also of interest.

A rather large number of interesting analytical results can be derived algebraically and computed numerically once a suitable P matrix has been fitted to a real process. For example, the mean first passage time to a target state and the variance of the first passage time to a target state may be computable for each possible entry state. If a subject has an option as to where to enter the process it might be possible to define for him a choice which would maximize his "expectation" or minimize his "risk" or even provide some minimax solution for him. Kemeny and Snell[6] derive many intriguing results to which psychological or sociological meanings might be attached, and numerical estimates of which might have practical value. There is also considerable literature on the problems of statistical inference which arise in the fitting of Markov models to sample data. We have found Suppes and Atkinson[7] most helpful on this subject. They give chi-square tests for several aspects of goodness of fit, including one for the stationarity of the process. At Buffalo we are planning two dissertation projects which we hope will supplement the present literature usefully. One of these projects will propose several methods of fitting a stationary transition matrix to human development data, which is likely to resist such a fit rather vigorously, and will demonstrate what is accomplished and at what cost by each of the methods. The other project will expose the numerical anatomy of many examples of finite Markov chains, tens of thousands of them, and will not only create an atlas to interesting populations of chains, but also create empirical sampling distributions for parameters of chains in those populations the expectations and variances of which are not given theoretically. A really general FORTRAN program for computing characteristics of Markov chains will also result. Through the study of very large random samples from populations of chains from which psychologists might select models we hope to acquire as orientation to the numerology of chains which cannot be acquired directly from cogitation of theory. For example, it seems clear that human development models will frequently involve transition matrices which are diagonal-dominated, or nearly so, allowing a great deal of stability in the short run. What are the other special characteristics of chains with diagonal-dominant P matrices? Again, longitudinal studies of human development are likely to yield data on a rather small number of transitions [once a year for twenty years, say], so that it will be desirable to fit chains for which the passage to the limiting matrix is accomplished in a small number of steps. Which chains enjoy this characteristic?

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[5] M. S. Bartlett, *op. cit.*, p. 12.

The required categorical variable observed repeatedly at intervals over time is not impossible to find in human developmental sequences. Marital status would be an example, also employed versus unemployed, hospitalized versus out-patient, probationed-jailed-paroled-unencumbered, drunk versus sober, and similar alternations of fortune which plague certain sub-populations in our culture. In career studies examples would be curriculum placement each semester of high school and college and vocational field placement and level placement in adult life. However, it seems that a more relaxed definition of a Markov variable might increase the applicability of the method to developmental data enormously. This relaxed definition would specify that a Markov variable may be one of a set of ordinal variables, each of which has the same number of levels k. It is desirable that k be a small number $2 [\leq k \leq 7]$. There must be a significant conceptual tie binding the set of variables together as a theoretical entity. In terms of this binding concept corresponding levels on the different variables should have a common interpretation. The binding concept might be achievement, in which case the first level on each variable would represent the highest achievement and the lowest level on each variable would represent the lowest achievement. Other examples of concepts which could organize a set of Markov variables would be aspiration, prestige, complexity, realism, and discrepancy. The context and content of the variables observed at the different stages would vary, but the interpretation of the levels would be unified by the binding concept. This concept would be the intervening variable the development over time of which the theory would attempt to account for, and the different observed variables in the Markov set would be acceptable indicators of the status of the latent variable. Under these rules, we should have no trouble defining sets of Markov variables to be collected and organized by regional data banks. The required categorical variables would be for the most part important overt memberships or expressed choices of the subjects. Many of them would be collected for census-taking purposes anyway. There would be little requirement for additional inventorying of the samples and no requirement for additional testing. [I do anticipate, however, that success with Markov chain models for some variables will lead to interest in stochastic models for the history of continuously distributed variables, such as test performances, collected repeatedly over time.]

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[6] J. G. Kemeny and J. L. Snell, Finite Markov chains. NY: Van Nostrand, 1960.

[7] P. Suppes and R. C. Atkinson, Markov learning models for multiperson interactions. California: Stanford University Press, 1960.

Theories of development framed as Markov models would have to be viewed as social psychology. They would describe the experiences of aggregates of people observed over time. Career development models so framed would have practical value in the rationalizing of manpower decisions, as represented by national scholarship-award and draft-exemption programs. It would be possible to predict the change in the final probability vector, representing the stabilized distribution of outcomes, to be expected if a change in a transition probability was brought about as a policy decision. They would also have value in guidance programs as the content of group instruction in the social psychology of careers, for the purpose of encouraging greater realism regarding the social context in which individual decisions are made. Perhaps their greatest value, however, would be as pioneering attempts at mathematical modelling of developmental processes, which might lead to more productive explorations of this style of theorizing.

Naturally, I am unwilling to deny our traditional trait-and-factor approach some place in this scheme. The only freedom accorded an individual in the Markov model is his choice of an entry point to the process. The role of individual differences methods can be in assessing the probabilities for an individual's entering at each of the possible entry points. I think the best way of assigning such a vector of starting probabilities is by use of Tatsuoka's classification probabilities,[8] which involve a quadratic form based on the individual's vector of trait or factor scores and the estimated means and dispersions of the groups which have entered at each of the entry points. It should be noted that Tatsuoka's probabilities can be computed in a discriminant function or factor space as easily as in an original variables space. I would suggest that much of the information stored in regional data banks should be stored as factor scores. It is possible to conceive of separate Markov models for each stage of a developmental process such as the career process.[9] Then, given a Markov model for the next stage, an individual's entry probabilities could be computed from his measurement vector by Tatsuoka's method. This information could be the basis for a guidance-counseling presentation. If the individual doesn't like the predictions, he still has time to do something in an attempt to upset them.

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[8] M. M. Tatsuoka, Joint-probability of membership and success in a group: an index which combines analysis as applied to the guidance problem. Harvard Studies in Career Development, Report 6. Cambridge, Mass.: Harvard Graduate

This type of research needs the support of data banks, but puts certain definite demands on those banks. These are: 1] probability samples, 2] long-term, short-interval longitudinal data collection, and 3] extensive measurement and census-type score vectors. Presumably these requirements will correspond to those to be made in support of most types of research anyway.

School of Education [mimeo.]. See also W. W. Cooley and P. R. Lohnes, Multivariate procedures for the behavioral sciences. NY: Wiley, 1962. Ch. 7, Classification procedures.

[9] See D. E. Super, *et al.*, Career development: self-concept theory. NY: College Entrance Examination Board, 1963, for the best discussion of postulated stages of career development.

NEEDED--NEW TEACHING MATERIALS FOR GUIDANCE

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The subject of this plea is information--the stuff of which decisions are made. But it is a very special class of information that is needed if decisions are to be made by the right persons. My concern as an educator is with the decision-making of my students. Although it is true that I personally *care* what they choose to do, that I hope the decisions of my students will lead to actions loosely termed desirable, these actions are not my professional concern. If a specified type of behavior were my only goal there would be no need for me to practice education; I could skip the student-decision-making step altogether and simply manipulate behavior by means of appropriate pressure or reward.

Rather than using the timeworn examples provided by totalitarianism (Hitler youth training) or indoctrination (military training to obey orders, or industrial training to sell a certain type of insurance, card, etc.) let us consider in capsule form the problem of space exploration. We want to know what's out there--how can we best find out? If the state of our technology were to permit, undoubtedly we would send a man to see just what is out there. Only because we cannot as yet send a man are robots sent instead; we are not very content with our robots and we send them only as poor substitutes. Why poor? Because these magnificently complex robots at best are only trained--they are not educated. We skip the step of their decision-making because we choose, in advance, the actions they will perform. Even where we leave a robot's decisions open to allow for contingencies we still choose its actions in advance, because the robot's *criteria* are directly built in by us. We are, in other words, concerned only with its ultimate actions.

I have taken the time to make this point because there is a great danger inherent in our present task of providing more informational power for educational functions. The better we become at techniques affecting students' decision-making the easier it becomes for us actually to choose *for* them. It becomes possible to produce robot-like students who, like the inevitable geologist's moonbug with a defective chemical laboratory in its innards, will march grimly and in neat patterns over the surface of an alien world, efficiently taking in bits and pieces of stuff that will never be rendered meaningful.

The information for which I plead, then, is information that will contribute to the process of liberating education, of education focused upon the students' need to choose for themselves.[2] There will be no need to fear power or efficiency in education so long as the goal remains more effective student decision-making rather than any preselected class of student actions.

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[2] Tiedeman and Field, 1962.

The Nature of Guidance Curricula

Previous statements have specified a broad spectrum of information that any human being needs in order to choose goals, plans, and instrumental actions effectively.[3] But the task set for this conference cannot be completed through abstractions such as the theory of purposeful action. Instead it is necessary to imageine oneself in an office with a student (or in a conference room with fifteen or more students as long as we're being realistic), and then to decide what we need to know in order to help them improve upon their decision-making.

In general we need a) to possess certain information, and b) to initiate processes or create situations whereby this information becomes a part of students' decision-making criteria. Yet this generalization applies just as well to what happens in guidance today as it does to what might be better for tomorrow. Still greater specificity is needed--what bits of information actually would improve a student's choosing, and what educational processes will make internalized choosing criteria out of external information provided by us?

The first question has been answered generally by Cooley (1964). Briefly, through the machine data processing operations of an organization such as NEEDS, it now could be determined for any one school or school system just what patterns of predictors lead to outcome X, Y, and Z--and how often. Through smaller scale operations in a guidance department it could then be determined, for young Mr. Kildare, that he closely resembles potential X's, looks only a little bit like a future Y, and in no way appears to be a budding Z. Finally, through efficient assessment methods or time-consuming counseling relationships, it can be determined that young Mr. Kildare wants very much to be a daring Z, that his parents expect him to become a good solid Y, and that X's really aren't very highly valued in the community where we are all operating. Red lights blink ominously!

Despite the anguished cries of those who prefer individual counseling this would be a clear improvement over current guidance practices--at least it would become so if data gathering programs were sufficiently clarified and established to permit machine processing of the data.

It is no longer terribly impractical to imagine a public school system gathering the same comprehensive information about 10,000 students that Cooley and twelve very part-time colleagues gathered on 700 boys involved in the *Career Development of Scientists Study* (Cooley, 1963). Indeed, if the less effective gathering techniques were weeded out it would be quite practical to gather even more comprehensive data, and on many more students. Furthermore, the necessary techniques are already available to evaluate such data in terms of what is likely to follow in the future for any individual with any pattern in the present. It only remains for the guidance practitioner to specify, before entering the conference room, the data to gather and the criteria by which it is to be analyzed. Back to the task, then.

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[3] Field, Kehas, and Tiedeman, 1962.
Field, 1964a; 1964b.

The information I have often wished I had when dealing with students can perhaps best be described as multi*disciplinary* as well as multivariate. By this I mean that I have often wished to know how diverse behavioral scientists would perceive the situation of this particular student--

1. What is his physical condition, and in the most comprehensive sense of the term physical. Can he feel, hear, see, and move in the world within normal limits? Or has a physician somewhere entered in a file the fact that this fellow has a neurological makeup seriously hindering one or more of the sensory-perceiving processes? Or what does it mean, if anything, that her eyes blink unusually rapidly, that continual fatigue is reported, that . . . etc. Lest this appear inappropriate, consider the number of children with neurological learning difficulties who have been packed off to a psychiatrist because they "won't" learn to read.

2. On the other end of the scale, how have cultural anthropologists economists, sociologists, and other more macrocosmic scientists described the community or com-unities that provided me with these students (and this PTA)? Within the school itself, what gross differences have been specified among the various value systems of students who *live* here and those of administrators or educators who *work* here?

Between these extremes are many classes of relevant information: achievements, aptitudes, interests, and personality variables; scholastic plans and programs; extra-curricular activities; work experiences; longtime developmental trends; and so on and on. Clearly these middlerange data are already considered important, and unlike the extremes of the microcosmic-macrocosmic dimension are commonly found in most students' records. But in what format?

A New Subject for Guidance Curricula

Cooley seeks far more than cumulative records reduced (partially) to IBM decks.

However, Cooley limits his subsequent discussion of guidance applications to "trouble spots"--to students with "high risk" plans in other words. Certainly the remedial aspects of a guidance program could be applied earlier and more effectively if the "record-scanning" aspects of individual assessment were done by machine. It would be easy enough to scan for excessively *low* risks, to expand the program to question the healthy-but-imperfect as well as the deviant. But as outlined in a previous statement[4] and as hinted earlier in this essay, not even these tremendous improvements can solve a long-standing problem of our educational system. That peculiar type of information with the power to link awareness and action still remains hidden under generalizations: "[over- and under-aspiring] . . . are frequent problems in educational and vocational planning, and if identified early, they might be remedied with suitable student experiences." (Cooley, 1964, p. 565) But how does such remediation *work*?

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[4] Field, 1964b.

At this point it becomes necessary to enter the guidance conference room again before the problem can be clarified. Thanks to NEEDS we now know, for each student in the group, a great deal more than we previously dreamed possible. If we wanted to forego education it would now be possible--perhaps not only in theory--to specify actions for each student that would make even a *circa 1984* personnel administrator proud! But because we are educators concerned with decision-making, not administrators concerned with the control of actions, our job remains undone. All we have accomplished so far is 1) an enormously improved list of data relevant for educational-vocational decisions, and 2) an improved and expanded list of students who appear to be ignorant of--or ignoring--significant chunks of this relevant information.

It is my allegation, and my principal reason for communicating such thoughts at this conference, that we who measure or evaluate measurements are to a large degree responsible for the counselor's remaining problem. We do so by making the counselor into a truly old-fashioned pedagogue, one whose curriculum might well shock the most authoritarian geography teacher in any vintage 1910 U. S. school. In effect, we do so by providing data that is relevant--perhaps even true--but in a format that scares off counselor and student alike. And our data does so for a number of currently correctable reasons--

1. It is perhaps most obvious that one problem is data format itself, in the narrowest sense of the word. Often it becomes necessary to teach elementary statistics before conveying test results, and not just to kids who are used to such new learning tasks, but to parents, officials, and other kids who are far from ready, or unwilling, or perhaps even unable to undertake such tasks. To some, the concept of being in the Xth percentile of high-school seniors on the CEEB Verbal is no more meaningful than to have displayed confabulatory Rorschach responses. So I enter a plea for *teachable* data as well as multidisciplinary and comprehensively analyzed data. Can programs be written that lead to printout containing individual data, locally normative data, career appropriateness data, plus some explanatory notes, diagrams, or whatever?

2. It is perhaps less obvious that reading readiness is receiving far more attention than is "career guidance readiness." If it is impossible for children below a certain developmental level to acquire reading skills, is it not also likely that some concepts regarding mankind, self, changes-in-self, social requirements in a free society, not to mention mature sexual adjustment, are lost upon persons who have not achieved divers other "readinesses"? So I enter a plea for data that includes supplementary

information identifying the kinds of persons who might and might not be able, or willing, or ready to use it.

3. Predictions used to be more keyed to the decision-*makers*, and less to us. Some of the more specific information students have needed pertains to transitional points at which a critical decision must be made. For example, in previous years, how many Freshmen in this institution have completed four years of college? What were these Freshmen and/or these colleges like? What were their majors? How well did they do? What did they do with it all afterwards? Of those who did not finish four years of college, what kinds of jobs were they able to get? What were these jobs like? What kind of additional training did they require? How successful were these ex-Freshmen in any such nonacademic work? In other words, what my students have asked me for (and about which I could often do no more than guess, or worse, reflect: "You're pretty angry and frustrated about being faced with such an important decision with such meager information . . .") is

a. knowledge of alternative educational or career routes beyond this point;

b. knowledge of the general odds; and

c. knowledge of what goes into the computation of these *general* odds, of how *personal* odds are "computed."

4. Some of the students in any conference room are not going on to college, perhaps not even through junior high school. It would be a pleasant innovation to provide them with comprehensive and clear data regarding alternatives from which to specify a career goal somewhat more positive and concrete than "non-college." Though exaggerated, this points to the undeniable fact that we have made our college- and graduate school-oriented predictive data far clearer and more palatable than the data we offer the intellectually below average, the under-motivated, the predelinquent, and the pregnant. The harder our data is likely to be for the individual student to take or use, seemingly, the less effort we expend to render it meaningful before selling it to the poor counselor in the field. So I enter a plea for data a) relevant to more classes of my students, and b) in format more appropriate to those students for whom it is most relevant.

One basic factor underlying my pleas is probably obvious by now. I need the more comprehensive individual data denoted by recent theoretical developments. I need the more locally interpreted individual-in-group data available when multivariate methods are applied to this more comprehensive data. I need access to a computer programmed to catch the subtleties--and the obvious but lost in numbers--that my poor brain cannot identify among 600 cumulative folders. But beyond this "more of the same but better," I especially need the measurement experts' help in conveying what I can now know *of* my students *to* my students. It is the students who need to know, because it is they and not I who must choose their actions.

APPENDIX "A"

Specifics of Data

The following broad data would be invaluable for research (collaborative among guidance, measurement and learning theory specialists) designed to develop a more teachable guidance curriculum.

Nature of sample and time period. Using Cooley's concept of an overlapping longitudinal study, a large sample could be drawn from any school system (in New England I would vote for one of the less researched systems, such as Somerville, Wayland, or Maynard, which also appear to have a *fairly* definable "community identity"). The sample would include a group from each grade--seniors down through at least the first year of highschool--each grade-level group large enough to permit solid statistical analyses. A time period of five years would permit for the senior group investigation through one year beyond college or through the first five years of work.

Multiple foci for assessment. Professionals and/or scientists from each of the behavioral or helping areas would select those tests, surveys, etc., that they would use in their own approach to the following categories of questions.

1. What are the students' capacities and limits for social living (notice that I do not say just for school):
   a. educational
   b. emotional
   c. financial
   d. intellectual
   e. parental
   f. physical
   g. social

   (Note: These are all relatively well defined already although they might be rather broad in scope for traditional educational testing standards.)
2. What are the students' desires, in both the positive and negative sense of:

a. What do they *want:*

   to learn to do

   to change

   to maintain or protect

   to become

b. What do they really *expect*:

   to learn to do

   to change

   to maintain

   to become

c. What do they dream of (or really want, or admit to wanting only in fantasy)?

(Note: It is not suggested that these are new categories of information so much as that they are currently under-investigated and almost never used in school testing programs)

3. What will the students tolerate, or risk, or undertake (again in the negative as well as the positive sense) in order to achieve these things or conditions that they want?

Discussion of data. (2) and (3) are obviously somewhat less traditional--why? The first answer is a paraphrase of Cooley's statement: Tell me what you want to know about your students; don't limit yourself to what you could comprehend all at once or to what your files can hold or to what your secretary can type up for X hundred of students, etc. etc. I can now render it all manageable for you.

The second part of the answer exists in a paraphrase of my own theorizing: Let's ask about our students in freedom from the theoretical limits we have invented or accepted to justify our pre-existing limits of comprehension and/or management. In other words, let's ask for some new types of information as well as for more and better traditional information. (Note: See *Appendix "B"* for an interview/questionnaire form which begins to specify these new types of data in more detail [suggested by the emerging theory of purposeful action])

Specifics of Format

Computer and outprinters work pretty fast. Consequently it might be worth switching our thinking about the advisability of work duplication. For example it might no longer be impractical to print 500 individual senior profiles complemented by 500 identical descriptions of this year's class, last year's, or other relevant norms. It might also be feasible now to have something which is not only clearer to the counselor, but something in black and white that the student can take home, puzzle over, discuss with his parents, etc. And if the data the student needs can be given him in context, with good explanation, perhaps at least some of it need not be given only to him. Perhaps we mistrust parents a bit too much when we tell only their children it's pretty unlikely they will be lawyers or doctors (or that it's quite likely, if only someone could encourage or pay for some of their education).

APPENDIX "B"

1. What high school curriculum did you take (assuming that there was a choice)?

2. How did you happen to end up in that one? Or were you influenced/directed by someone? Whom?

3. Up to now, what subject (or type of subject) have you liked best? Can you say why? What did you like least?

4. Where do you *plan* to go after CBS?

5. If you had to bet a large amount of your own money on "I will end up doing/being ____________________ in 6 or 8 years," what would you bet on? Assume that you *have to* place a bet--what appears to be the safest bet?

6. Is this what you also hope you will be doing by then? If not, what *do* you hope to be doing--what do you hope to be?

7. Now pretend you're writing a play, and one of the scenes involves you "at work": set the stage. What is going on, where, for what purpose, with whom, to whom, etc., what is it like; etc.

8. What is the big attraction in this occupation? What do you feel you will "get out of it"?

9. Suppose there were ten identical jobs doing/being this exact same thing, but under slightly different conditions? What would cause you to choose one of these over the others, or reject one before the others? In other words, what will you look for in the specific job you accept *within* any occupation?

10. What do you think will be the toughest hurdle you have to get over between now and then? Not that there has to be some serious difficulty--just indicate what you think will be the *hardest* task even if you feel it will all be relatively easy.

11. How much of a hurdle do you think this will be?

12. Suppose we gave you a magic button to press--one that would make you be, or able to do anything at all. It would give you all the training, talent, skill, ability, opportunity, money, etc. that would be necessary--whatever you needed. What would be the best possible job for you? (or impossible, just so long as you'd like it best)? If you have great difficulty choosing among severl, list them all. If you can't specify anything about the best--what would be the worst?

13. (OPTIONAL) What would the magic button have to change about you to make this ideal job possible for you? In other words, where would the magic need to have the most effect?

14. Any comments you want to make about these questions?

15. Any way you want to add--clarify?

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SYSTEMS ANALYSIS IN EDUCATION

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We are all familiar with the modern trend toward bigger and better words to glorify the commonplace or the poorly understood. Yesterday's janitor is today's custodian, and garbage collectors have been replaced by sanitary service personnel. Doctors call that little white spot you may have on your shoulder a "leucoplakia," which means literally, "white spot." In the military field, in industry, and more recently in education, the terms "systems approach," "systems analysis," and "systems design" have gained some popularity. Because these "systems" terms have been used to loosely, frequently as new labels for things we have already known by other names, the listener may be led to feel that there has been no real progress beyond the discovery of a fancier vocabulary. Nevertheless, I believe that the last decade *has* produced some important developments in our way of looking at, and improving, the structure and operations of complex organizations involving both men and machines. "Systems approach" is the name we have applied to this new perspective, and systems analysis and design are techniques that can be applied to systems problems. During the next 20 or 30 minutes I plan to talk about systems analysis in education, which certainly includes some highly complex man-machine systems. To make these words more than a catch phrase, I will describe the systems analysis process in fairly concrete terms, giving specific examples of the procedures and products of such analyses. Finally, I plan to discuss briefly some possible implications of systems analysis procedures for educational data banks.

It is important, first, to distinguish between two uses of the term, "systems analysis," one use being much more restrictive than the other. The more limited definition, as stated by Alexander Mood at a recent conference on the systems approach in instruction, treats the term "systems analysis" as interchangeable with "operations analysis." When used in this sense, according to Mood, "systems analysis means the analytic techniques which consist of constructing a mathematical model of a phenomenon and optimizing some function of the variables involved in the model." Such an approach traditionally applies mathematical solutions to problems of inventory, allocation, queuing, sequencing, replacement, search, and competition.

An example is the type of analysis advocated by the RAND Corporation, in a paper entitled, "Systems Analysis and Education." Kershaw and McKean, authors of the paper, recommended that analysis of covariance be used to isolate significant input variables in education. They suggested that data be collected from many schools on a large number of variables such as teacher salary, student/teacher ratio, and educational television usage. The significant variables would be those that related to a significant increase in the scores of graduates on standardized achievement tests.

At System Development Corporation we have used a somewhat different, and less restrictive, approach to systems analysis in education. While mathematical modeling may be employed in our analyses, the primary focus is on the detailed description of operations, rather than on mathematical representations or solutions. Special emphasis is placed on the flow of information within the system, but our interests also include the design problems of planning and allocating material resources, the problems of planning space, the role of personnel, and the decision-making procedures of the system.

Our *immediate* goal in conducting a systems analysis is to gain a better understanding of the critical operations and interactions of the school system. Our *ultimate* objective, however, is to make design changes leading to improved operations. For this reason, we view the analysis as one step in a series of steps toward systems improvement. The full series includes systems analysis, systems design, systems test, and systems implementation. I think it's worth taking just a minute at this point to consider the relationships among these steps.

In the *analysis* phase our objective is to specify the systems structure and operations so that we can identify critical problems--problems that must be given special consideration in any new design. This stage helps us to identify logical errors in the planning, to uncover glaring oversights, and to detect unnecessary overlap in the operations. It is an absolute prerequisite to efficient systems improvement.

In the *design* phase, improved designs are *formulated*. The design recommendation may include improved procedures for handling information, modification of the decision-making procedures, and changes in the role of personnel and in the application of material resources.

The *systems test* phase is an evaluation of the design recommendations, before implementation. Simulation techniques and field test techniques may be employed. In the case of *simulation*, the design improvements may be tested under laboratory conditions with *people* playing key roles in the procedures.

The *implementation* phase of the systems approach is concerned with the installation of the tested design changes. Training of personnel is usually of primary interest to the implementation staff.

Now let's look at the systems analysis itself in more detail, starting with the types of data collected.

Systems Analysis in Education

Systems Analysis Inputs

The specific types of information we collect in a systems analysis are determined by the objectives of the analysis, but usually they include the following:

1. *Statistical* data of the sort conventionally found in school surveys. These figures might include, for example, the school budget, the total number of students, the number who enter and who graduate each

year, the number of teachers with credentials, and the number of square feet of floor space in the school buildings.

2. Organization charts showing the administrative structure of the school, as officially represented by the school or district.

3. Rules and regulations issued by the school and district administration, to regulate the school operations.

4. Procedural descriptions. These descriptions, usually represented by flow-charts and verbal summaries, depict the schools' operations and procedures as it responds to the needs of pupils, staff, parents, and community. In most instances, they provide a much more realistic and detailed picture of the school than do the official organization charts and school regulations. And, unlike the conventional school statistics, they show the actual sequence of actions taken by the school personnel in applying the school's resources to solve its operational problems. The primary focus of the charts is on the decision structure and information flow within the school, and between the school and external agencies.

Products of the Systems Analysis

School statistics can be quantified and summarized in conventional tabular form, but the major products of a systems analysis, the procedural descriptions, are represented in flow charts. Often, three sets of charts are prepared, showing different levels of detail of the schools' operations. One chart, for example, may depict the major functional subsystems (e.g., instruction, administration, counseling), and shows the general types of interactions among those subsystems.

A second set of charts may show, in greater detail, the operations and interactions within each of the subsystems. One such chart, for example, might break out the detailed operations of the *instructional* system, and another the *counseling* function.

The third set of flow charts may describe typical, or particularly important, problems to be met by the school. A chart in this set might cut across all of the school subsystems; it would show how these subsystems interact to solve a particular type of problem, such as how to remedy a high dropout rate.

In the following slides I have attempted to illustrate the kinds of flow in a school where students are allowed to move at their own rate through the instructional material. Information is shown moving toward or away from the school's information processing center. (See Figure 1.) Other major functional systems represented are administration, academic departments, a counseling service, and a materials center. Shown in supporting roles are the business office, food service, buildings and grounds, and transportation.

The information processing center is centrally located in this particular chart, because the focus of attention in the analysis was on the novel information-processing techniques of the school. If the analysis had been primarily concerned with *business* operations, the business office might have been shown in the center, with other functions located peripherally.

Interactions are shown at a very general level in this chart. For example, one arrow shows test results being transmitted from the counseling service to the information processing center, while two others show registration information being sent from the information processing center to the academic departments and to the materials center.

The next slide (see Figure 2) shows a somewhat more detailed account of one portion of the total school system. It describes part of a student's movement through a continuous-progress instructional program. A series of such charts would be produced in a typical systems analysis.

In the first box, the student is shown being registered and assigned to certain classes. At this point he would actually begin several parallel operations, corresponding to the different courses he is taking, but for simplicity I have shown only one course. The course is introduced (box 2) with a presentation of the course objectives and a general outline of the topical sequence leading to those objectives. The student is given a set of materials, and after a brief discussion period he is ready to begin his study.

At this point, a decision is made as to whether the student should start in a group or individual study mode (box 3). If the student has previously demonstrated a thorough knowledge of all the prerequisite skills in this particular field, and if his aptitude scores and earlier performance qualify him as a relatively advanced student, he may be assigned initially to a group study mode. In the group mode, more advanced concepts are presented, and group discussion and laboratory projects are encouraged.

In this case, however, we will assume that the student is assigned to an individual study mode, where course fundamentals will be emphasized. The first concept is introduced to the student by means of individualized study materials that allow him to progress at his own rate (boxes 4 and 5). He may have access to programmed textbooks and to more conventional library resources such as reference books and microfilms.

The student studies in this mode until he asks for help (box 6), or until he completes the concept and is ready to be evaluated. If the student asks for help, or if his rate of progress is inadequate (box 7), he is assisted by a teacher or counselor (box 8), after which he returns to the individual study mode.

When the student completes the concept, he is tested to determine whether his knowledge is adequate for him to move to more advanced materials (box 9). If so, the next concept is introduced (box 11), and the basic study cycle is repeated. If his performance is not adequate, he is given supplementary materials for the topic he has been studying (box 10) and is returned to the individual study mode.

Although it is not shown on this abbreviated flow chart, the student is also given a more comprehensive set of diagnostic materials at periodic intervals, to determine whether he should remain in the individual study mode or be assigned to a group mode. Eventually he completes all the topics in the course and is either assigned to new courses or graduated.

In the flow chart you have just been looking at, the entire pupil registration process is shown as a single box. The next slide shows a breakdown of the major registration activities (see Figure 3). The student reports to the counselor (box 1), who informs the student of his performance on pre-entry examinations (box 2). Test results are interpreted by the counselor, so that the student will have a better basis for picking his major subject and for selecting the general sequence of courses by which he can meet his graduation requirements (box 3). The counselor also advises the student on the courses available to him during the semester (box 4), and the student selects a set of courses (box 5). Based on various test scores, and on previous grades, the counselor computes "expectancies" for the student (box 6). These expectancies set a progress schedule for the student and provide a reference against which his actual progress can be evaluated. The counselor and student discuss these expectancies, which are adjusted where necessary to make them agreeable to both parties. The student then proceeds with further registration activities, not shown in this chart.

Depending on the purpose of the systems analysis, further flow charts might be prepared, showing even greater detail of each of the registration activities. For example, a sizeable flow chart would be needed to show the exact procedures by which the counselor computes expectancies for each student.

Wherever possible, we would record *times* associated with each of the major activities. For example, we might indicate the mean value and range of times required for a student to complete a given study unit, or for a counselor to calculate an expectancy.

Typical Systems Analysis Schedule

To provide a more concrete picture of the systems analysis operation, I would like to describe the sequence of activities for a typical school analysis.

One or two analysts travel to the school, where they interview several key members of the administrative staff. Generally, these members will include a district representative, the school principal, and perhaps a curriculum supervisor and a counselor. The analysts may spend an hour or more with each person, attempting to get an overall formulation of the general allocation of responsibilities among staff members. Particular attention is paid to any unusual procedures or organizational innovations. Notes are taken of all conversations.

After the initial interviews, the analysts return to "home base" to write up more complete accounts of the interviews and to formulate the information in general flow diagrams. This process, which may take on or two weeks, gives the analysts a clearer picture of the total school structure. The analysts may identify gaps in their data, which will have to be filled by a second interview with some of the administrative personnel.

When the general flow charts have been completed, the analysts return to the school to collect more detailed information about the individual school operations. On this trip they may talk to teachers, counselors, librarians, and clerks. In addition, the analysts observe the school operations to gather first-hand impressions of the actual decision structure and communication flow. These interviews and observations may require several days, at the end of which the analysts again return to SDC to formulate their information in the more systematic, comprehensible form of flow diagrams. Each time they add new information and prepare new flow diagrams, the analysts are better able to identify the most critical operations and to determine what activities should be analyzed more thoroughly.

For a typical systems analysis of a single school, from five to ten cycles of interviews, observations, and formulation may be required. These may be extended over a total period of six weeks or more.

Implication of Systems Analysis for Data Banks

In the remaining portion of this paper, I would like to discuss possible relationships between the systems analysis approach, as we and others have used this term, and the educational data bank.

Clearly, neither the systems analysis nor the data bank is an end in itself; both are tools that we may exploit to learn more about the educational process and to help us in planning more effective schools. We *could* look upon the data bank as a source of information to be fed into systems analyses. This approach might be highly appropriate for the type of analysis recommended by Kershaw and McKean. The analysis could draw upon the data bank for information about such input variables as the pupil/teacher ratio, staff salaries, percentage of accredited teachers and per/pupil tax expenditures. These variables could then be related to "success indices" such as student scores on standardized achievement tests. Alternatively, and adopting the broader definition of systems analysis that we use at SDC, we can view the analysis as an important means of collecting information for the data bank. I believe that the real potentials of the educational data bank can only be realized if it includes such information. If the data bank is to have its greatest applicability for educational research, design, and planning, it must include information about the dynamic organization and procedures of the school system, as well as the more static information conventionally collected in school surveys.

The inclusion of dynamic information in a data bank will certainly not be without cost. Much more time and effort is required to obtain this kind of information than to collect survey statistics. In part, this extra cost results from the greater precision with which the systems analysis examines the operational activities within a school system. In a total systems analysis we do not stop with a schematic box labeled, for example, "administration." We look in great detail at the organizational structure, the information network, the decision structure and the operational flow within that box.

The cost of systems analysis cannot, however, be wholly explained by the level of specificity of the data collected, since relatively inexpensive school surveys often include extremely detailed information. Rather, the cost results primarily from the basic nature of systems analysis data, and from our lack of standardized instruments and procedures for collecting the data.

In such analyses our major focus is on change and on dynamic interactions. We are interested not so much in the school's resources *per se*, but in the way those resources are applied by the school to meet the changing needs of students, staff, and community. Our unit of analysis is the response, the reaction, and the decision. Our entire analysis, ultimately, is aimed toward discovering how a school system, real or hypothetical, detects and responds to internal or external needs.

But, given this general objective, what are the specific questions that we must ask about any particular school? At present, unfortunately, we have neither the theoretical nor the practical knowledge to specify a set of operational questions that will satisfy our data needs for all schools. The kinds of data with which we are primarily concerned do not, as yet, lend themselves to precise categorization. Because we have no standardized formats or accounting procedures that can be mechanically applied to every school, data collection is a slow, expensive process.

At this stage, systems analysis is more an art than a science. To be sure, before we visit a school we have lists of questions to be answered; there are certain things that we always look for. We can even get some of this information by mailed questionnaires. But it is only after we have actually spent several days in the district that we really know what questions are likely to be most critical. The response to one question, for example, may cause the analyst to view a particular communication channel as being of central importance in a major school operation. He may then follow up with a series of increasingly detailed questions focusing more and more sharply on the procedures used in the control and maintenance of that communication channel. Some other operation he may study much more superficially, because from his early questions he has concluded that this operation is fairly unimportant. The analyst's success in identifying and answering critical questions about the schools' operations depends less on any standardized checklist procedures available today, than on his own perception, intelligence, and experience with similar analyses.

Eventually it should be possible to standardize the data collection procedures to a much greater extent, thereby providing a more scientific footing for the systems analysis. We believe it may ultimately be possible for us to represent the entire analysis procedure as a series of logical decisions, in flow chart format. The chart would include every question that might be asked about a school, but for any particular school the analyst would need to ask only a subset of those questions. The response to the first question would determine what question the analyst should next ask, the response to the second question would direct him to some new sequence of questions, and so on through the entire logical tree. Initial questions would probably deal at a fairly general level with major functional divisions of the school, but later questions would become increasingly detailed and specific. In short, the flow chart would give the analyst a systematic, standardized procedure for determining the sequence of questions that he needs to ask about the school system. If such a flow chart can be developed, it should greatly increase the comparability of systems analysis data from one analyst to another, and from one school to another. It should also speed the data-collection process considerably.

However, even with standardized procedures of this sort it will probably still be necessary to send analysts to the schools, rather than depend on the school personnel to fill in the data themselves. It is doubtful that the school personnel can view their own operations and procedures with the necessary degree of objectivity.

Regardless of what progress may be made in standardizing data collection procedures, there will clearly be a need for great flexibility in the construction of educational data banks if they are to incorporate the products of system analyses. These products, depicting school communications and decision processes in flow charts and other graphical formats, are not readily adaptable to tabular or mathematical summarization, though perhaps they could be microfilmed and included in a computer-based document-retrieval system.

Yet, in the long run it is precisely such awkward, difficult-to-quantify data taht often prove most significant in educational research, and most directly related to indices of school effectiveness. I believe that, by incorporating the flexibility needed to accommodate such data, rather than striving for apparent efficiency through early simplification and standardization of the data storage and retrieval procedures, the data bank can ultimately be made a powerful resource for educational research.

INFORMATION FLOW IN A CONTINUOUS PROGRESS SCHOOL

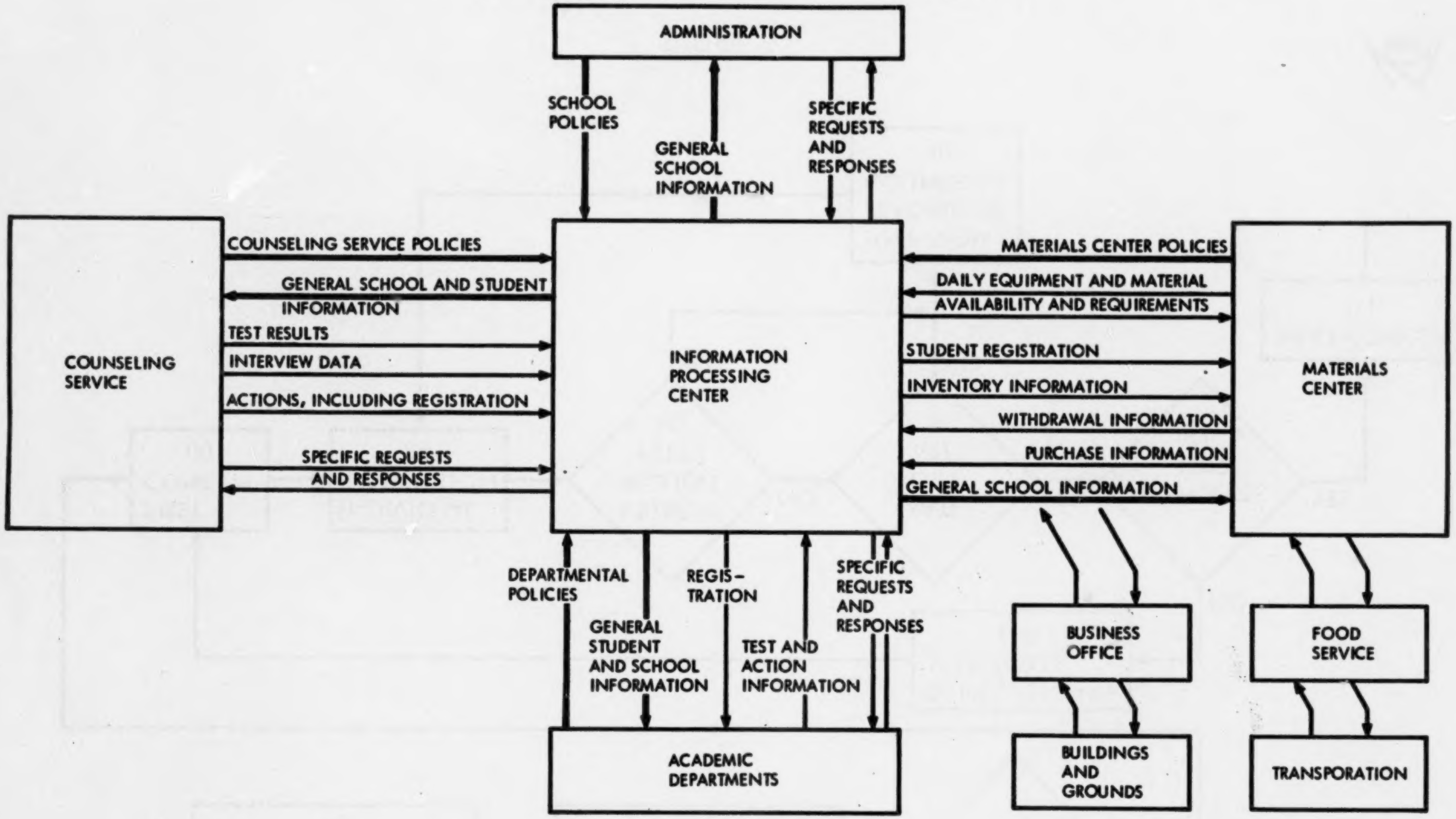
ADMINISTRATION
SCHOOL POLICIES
GENERAL SCHOOL INFORMATION
SPECIFIC REQUESTS AND RESPONSES
COUNSELING SERVICE
COUNSELING SERVICE POLICIES
GENERAL SCHOOL AND STUDENT INFORMATION
TEST RESULTS
INTERVIEW DATA
ACTIONS, INCLUDING REGISTRATION
SPECIFIC REQUESTS AND RESPONSES
INFORMATION PROCESSING CENTER
MATERIALS CENTER POLICIES
DAILY EQUIPMENT AND MATERIAL
AVAILABILITY AND REQUIREMENTS
STUDENT REGISTRATION
INVENTORY INFORMATION
WITHDRAWAL INFORMATION
PURCHASE INFORMATION
GENERAL SCHOOL INFORMATION
MATERIALS CENTER
DEPARTMENTAL POLICIES
GENERAL STUDENT AND SCHOOL INFORMATION
REGIS-TRATION
TEST AND ACTION INFORMATION
SPECIFIC REQUESTS AND RESPONSES
ACADEMIC DEPARTMENTS
BUSINESS OFFICE
BUILDINGS AND GROUNDS
FOOD SERVICE
TRANSPORATION

FIGURE 1

INDIVIDUAL-STUDENT PROGRAM

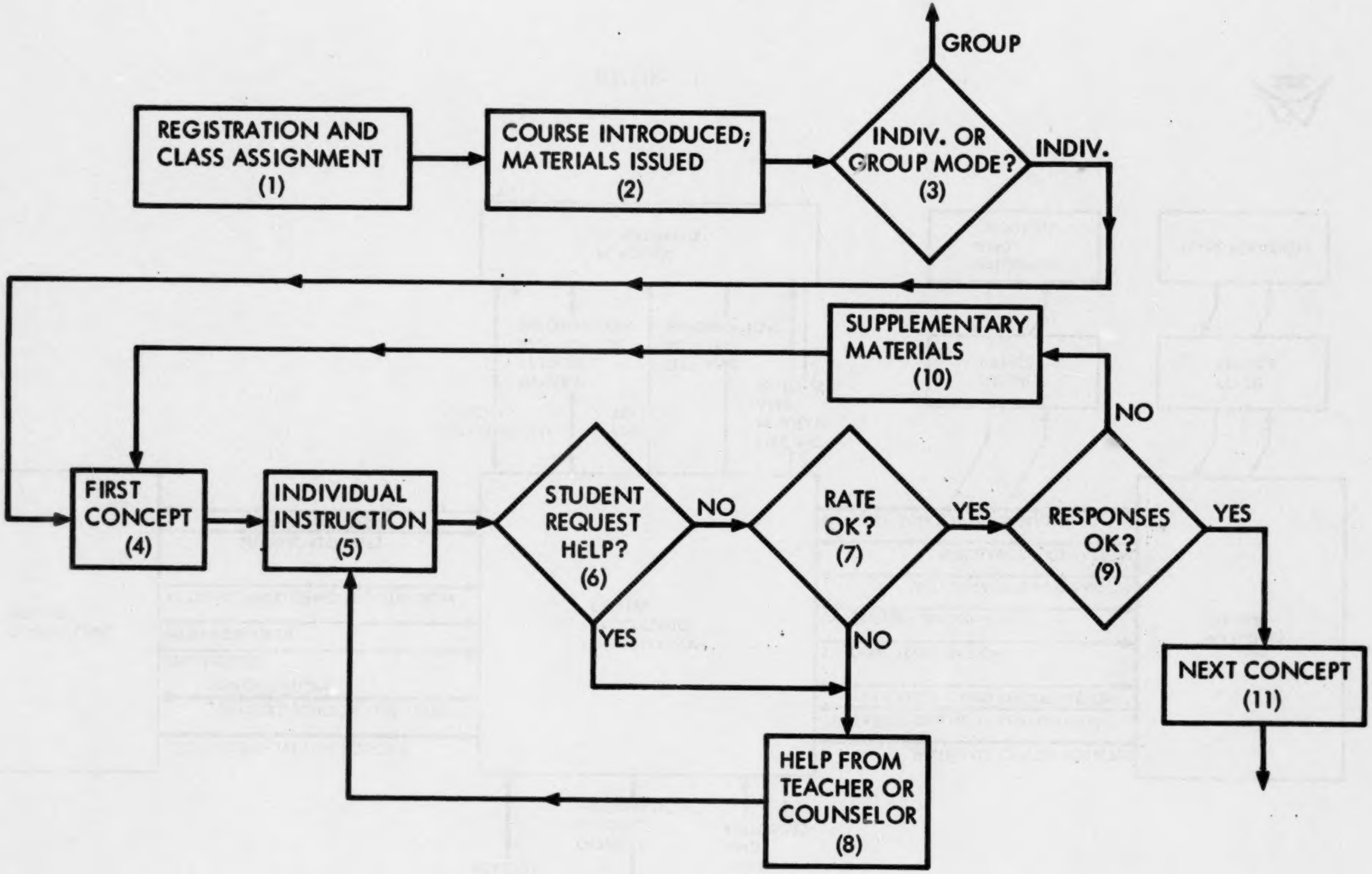
GROUP
REGISTRATION AND CLASS ASSIGNMENT (1)
COURSE INTRODUCED; MATERIALS ISSUED (2)
INDIV. OR GROUP MODE? (3)
INDIV.
SUPPLEMENTARY MATERIALS (10)
NO
FIRST CONCEPT (4)
INDIVIDUAL INSTRUCTION (5)
STUDENT REQUEST HELP? (6)
NO
RATE OK? (7)
YES
RESPONSES OK? (9)
YES
YES
NO
NEXT CONCEPT (11)
HELP FROM TEACHER OR COUNSELOR (8)

FIGURE 2

REGISTRATION

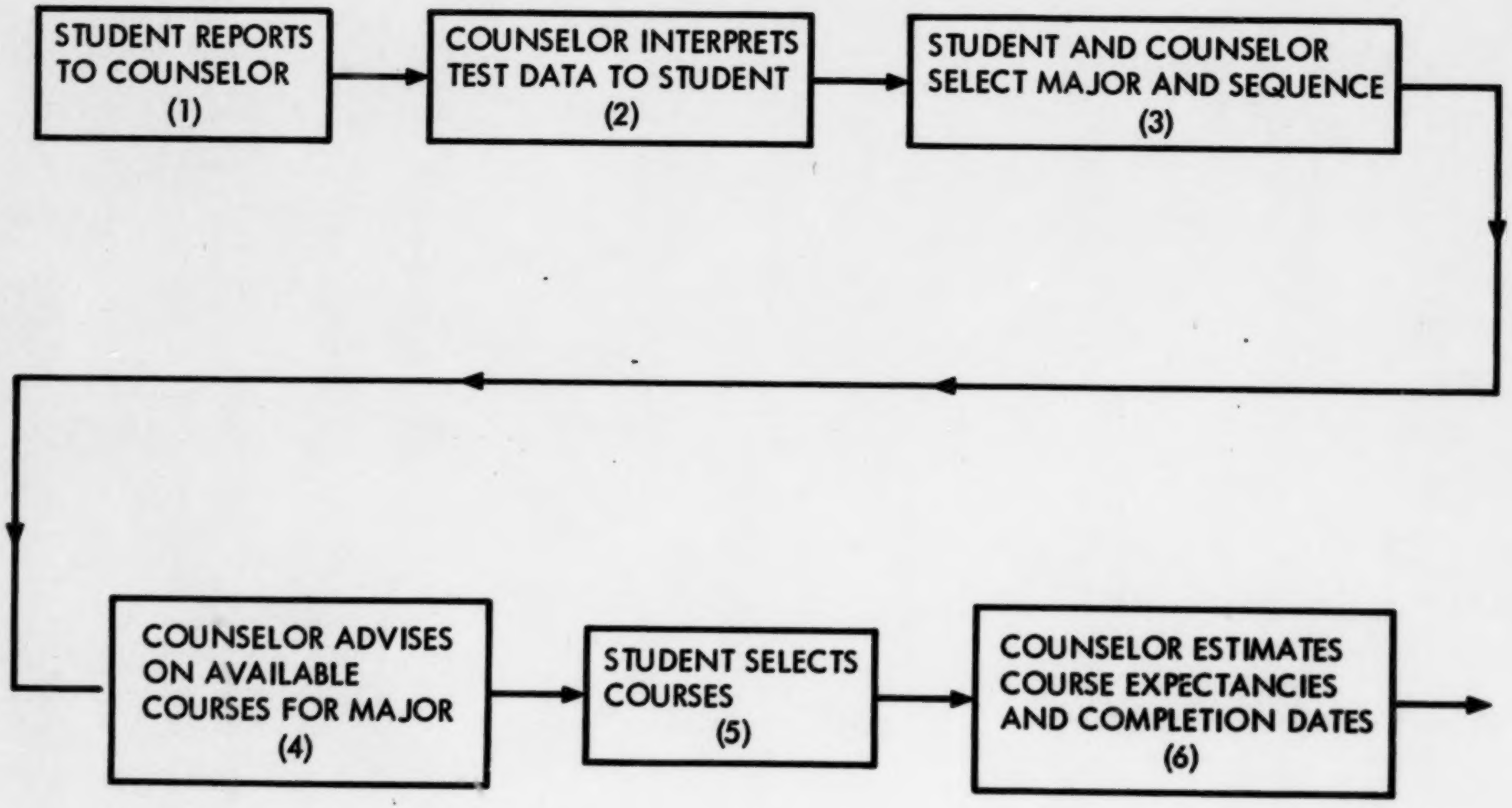
STUDENT REPORTS TO COUNSELOR (1)
COUNSELOR INTERPRETS TEST DATA TO STUDENT (2)
STUDENT AND COUNSELOR SELECT MAJOR AND SEQUENCE (3)
COUNSELOR ADVISES ON AVAILABLE COURSES FOR MAJOR (4)
STUDENT SELECTS COURSES (5)
COUNSELOR ESTIMATES COURSE EXPECTANCIES AND COMPLETION DATES (6)

FIGURE 3